HD 9019 - HD 9020

ENGLISH

INTEGRATING SOUND LEVEL METER
HD 9019 REV. 98 A
HD 9020 REV. 98 A

TECHNICAL SPECIFICATIONS

- Integrating type 1 sound level meter according to IEC 651 and IEC 804 (CEI EN 60651/1994, CEI EN 60804/1994).
- Converter dynamics range: 84 dB.
- Input amplifier: 0÷60 dB by 20 dB steps.
- Interchangeable probes.
- Frequency weightings: A, B, C, D (**HD 9019 only**), LIN (16 Hz÷16 kHz) and 1/3 octave band filters from 16 Hz to 20 kHz, type 2 according to IEC 1260 (CEI EN 61260/1995).
- Equivalent continuous sound pressure level (Leq) measured on programmable time intervals from 0.125 s to 12 h.
- Sound pressure level (SPL) measurement with SLOW, FAST or IMPULSE weighting.
- Peak level measurement with rise time lower than 50 ms.
- Sound Exposure Level (SEL) measurement.
- Calculation of current and estimated 8-hour Dose with programmable Threshold, Criterion Level and Exchange Rate (ANSI S1.4 1983 and BS 6402); **HD 9019 only**.
- 512 kByte FLASH memory for data storage, capable of storing, for more than 8 hours, measurements at 8-sample/second.
- Leq monitoring and storage program with programmable threshold for noise event triggering and statistical analysis (ISO 1996).
- Program for frequency analysis of sound sources with automatic scanning of one-third octave bands.
- Calculation program of reverberation time (ISO 354 and ISO 3382); **HD 9019 only**.
- Automatic calibration procedure with HD 9101 and HD 9102 calibrators.
- Time and date.
- Storage of maximum and minimum sound pressure levels.
- Mains power supply through a 6÷9 Vdc external power supplier (optional).
- Power: 4 x IEC R6.AA.UM3 1.5V alkaline batteries (15-hour life).
- Auto power-off.
- DC 20 mV/dB output.
- Pre and post-filter AC outputs.
- Sound generator control output for reverberation time measurement (**HD 9019 only**).
- RS-232C serial interface for direct printing of measured values, data download from memory (memory dump) and remote control.

- Microphone probe accessories:
- 3 m extension cable;
- tripod (optional);
- windscreen.

MICROPHONE PROBES

HD 9019S/1:
• 125 dBA dynamic range.
• Maximum measurable Sound Pressure Level: 140 dB (143 dB peak).
• Standard connection for 1/2" microphones.
• Condenser microphone for free-field measurements (CEI EN 61094-4/1997).

INTRODUCTION

The sound level meter is an instrument that perceives a noise or a sound similarly to the human ear and provides reproducible measurements of the sound level.
HD 9019 and HD 9020 are robust instruments, weighting only 650 g and easy-to carry. They are suitable to measure environmental noises in communities, in industrial and residential areas, or in the airports and of traffic. They are also used to measure and analyse single noise sources, as well as impulse sources.
These meters are also designed to measure noise in the industrial environment to determine a noise disturbance and possible hearing injuries.
The convenient button lay-out on keyboard makes the functions easy-to-understand; symbols available on LCD provide an easy data reading, as well as an understanding of the instrument measurement state at a glance.
The instruments measure and calculate SPL, Leq (from 0.125s to 12 h), SEL, 8-hour estimated Dose and current Dose (**HD 9019 only**), Peak; they are capable to select and store noise events and to process the statistical analysis. They are also allowed to carry out a frequency analysis of stable and repeatable noises through an automatic scanning of 1/3 octave filters from 16 Hz to 20 kHz. By means of a continuous or impulsive external sound source, the instrument can calculate (**HD 9019 only**) the reverberation time either in a small room, or in a large auditorium (up to 5 s with 0.01 s resolution)

HD 9019 and HD 9020 sound level meter technical specifications comply with the following standards:
• IEC 651 “Sound level meters”.
• IEC 804 “Integrating-averaging sound level meters”.
• IEC 1260:1995 “Octave-band and fractional-octave-band filters”.
• IEC 537 “Frequency weighting for the measurement of aircraft noise (D-weighting)” **HD 9019 only**.
• BS 6402 “Specification for personal noise dosimeters” (**HD 9019 only**).
• ANSI S1.4 1983 (**HD 9019 only**).
• ISO 354 “Measurement of sound absorption in a reverberation room” (**HD 9019 only**).
• ISO 3382 “Measurement of reverberation time in auditoria” (**HD 9019 only**).
• ISO 1996-1 “Description and measurement of environmental noise - Basic quantities and procedures”.
• ISO 1996-2 “... - Acquisition of data pertinent to land use”.
• ISO 1996-3 “... - Application to noise limits”.

IEC 651 and IEC 804 standards define the specifications of a sound level meter, assigning an accuracy type to it:
- Type 0: laboratory reference standard instrument.
- Type 1: precision instrument suitable for laboratory applications and for general purposes when the acoustic conditions can be accurately specified and controlled; measurement accuracy achievable through this instrument will not be reached by standard conditions.
- Type 2: general purpose instrument.
- Type 3: first-inspection instrument.

These standards define also the sound level meter specifications for measurements where a temperature change from -10°C to 50°C and a relative humidity change from 30% to 90% will produce (singularly) up to ±0.5 dB reading change with respect to the calibration carried out in reference conditions. By ±10% atmospheric pressure changes, the maximum reading variation with respect to the calibration in reference conditions shall not exceed ±0.3 dB.

HD 9019 and HD 9020 are type 1 precision integrating sound level meters according to IEC 651 and IEC 804 standards, suitable for on-field measurements.

Besides a filter with flat frequency response in the 16 Hz÷16 kHz range, these meters incorporate the following frequency weighting filters:
- "A" filter, according to "A" weighting curve (IEC 651)
- "B" filter, according to "B" weighting curve (IEC 651)
- "C" filter, according to "C" weighting curve (IEC 651)
- "D" filter, according to "D" weighting curve (IEC 537) (**HD 9019 only**)
- 1/3 octave filters with centre frequencies from 16 Hz to 20 kHz (IEC 1260)

The meters can measure SPL, with selectable FAST, SLOW or IMPULSE time weightings, Leq with a 0.125 s÷12 h integration time, SEL and current and estimated Dose, contemporaneously. (**HD 9019 only**).
They can also measure the Peak level with a rise time lower than 50 µs.

Data relevant to executed measurements can either be sent directly to a printer, or can be stored on the integrated permanent FLASH memory.
Stored data can then be printed directly from the instrument, or downloaded to a PC.
Stored data, as well as the instrument configuration and its calibrating values remain stored on memory even taking batteries off.

The instruments are equipped with a calendar clock.

WARNING

HD 9019 and HD 9020 are precision instruments. To preserve their features as long as possible, they have to be used paying care not to damage them.

It is suggested to:

- Read the user's manual before using them.
- Keep them far from heating sources.
- Keep them far from water splashes.
- Avoid bending or forcing connectors, or trying to connect non-compatible connectors.
- Avoid sudden temperature changes and condensate.
- Avoid placing the instruments on surfaces subject to strong vibrations.
- Avoid using the instruments in environments where steams, salts or corrosive gases are present.
- Avoid cleaning the instrument case with products not suitable for plastics.
- Use best quality batteries. Should the instrument not be used for quite a long time, it is suggested to take them off their seat to avoid the leakage of corrosive liquids.
- Handle the condenser microphone with great care: falling or crashing might cause it irreparable damages.
- Be sure that the instrument is properly calibrated. It is recommended to control it with a calibrator before and after every series of measurements.
- Make some trial measurements before starting effective operations, so that you can realize which is the sound range where you are operating and which is the kind of noise to be examined, as well as the best position to choose to make measurements.
- **Use the windscreen every time you work outdoor or next to machines with moving parts or, more generally, in dusty environments.**
- Try to avoid using the instrument in overload conditions (OVFL indicator).

CAUTION:

- **IT IS EXTREMELY IMPORTANT THAT THE CONNECTION BETWEEN PROBE AND INSTRUMENT/OR EXTENSION CABLE BE MADE BY INSTRUMENT OFF.**
- **INSERT INTO OR TAKE OFF THE PROBE FROM THE CALIBRATOR SEAT WITH BOTH INSTRUMENT AND CALIBRATOR OFF.**
- **DO NOT REMOVE THE MICROPHONE PROTECTION GRID IF NOT STRICTLY NECESSARY. IN ANY CASE, THIS OPERATION HAS TO BE CARRIED OUT BY TRAINED PERSONNEL.**

POWER SUPPLY

The instrument is powered by 4 x IEC R6.AA.UM3 1.5V alkaline batteries. Best quality alkaline batteries grant a 15-hour life.
The meter can be mains-connected through a power supplier; rated voltage shall be included in the 6÷9 Vdc range and the power supplier shall deliver 200 mA minimum. Pay attention to the input plug polarity; the positive terminal has to be connected to the plug central terminal.
When, by standard working, the battery symbol is continuously lit up, it means that batteries are low and that the instrument will work for approximately one more hour. To replace batteries, slide the cover on the bottom of the instrument, take batteries off, replace them with new ones and close the cover again.
Pay attention not to invert battery polarity and replace always all batteries **at the same time.**
Use always new batteries.
Switch the instrument off before replacing batteries.

MALFUNCTIONING UPON POWER-ON AFTER REPLACING BATTERIES

After a general reset, instruments execute a 4-step memory automatic check, taking about 3 minutes.
If, after changing batteries, the display should not work anymore or the instrument should not switch-on/ off, repeat battery replacement operation, keeping batteries disconnected for a few minutes. In this way, the circuit capacitors will exhaust completely. Then insert batteries again. If malfunctioning still persists, consider that applied batteries might be exhausted.
Remember that also new batteries that have not been used for a long time loose their charge because of the self-discharge process.

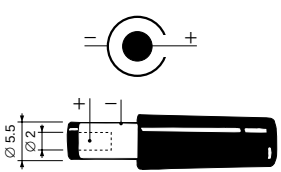
CONNECTOR FUNCTION

A DIN 8-pole connector is located on the front.
The probe or the extension cable can be directly connected to this connector. Both the probe and the instrument have a positioning notch, while a threaded locking ring grants a tight hold.

The following connectors/sockets are located on the instrument right side starting from the bottom upwards:

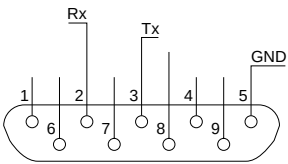
1) 20 mV/dB analogue output socket, 470 ohm output impedance.
   Plug dimensions are:

2) Male connector for external 6÷9 Vdc power supply.
   The male connector diameter is 5.5x2 mm; the central pin corresponds to the power supply positive pole.



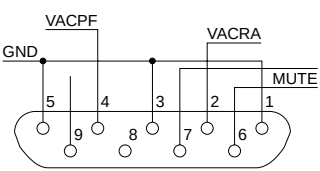
3) RS-232C D 9-pole male connector.
The serial link uses three lines: TX, RX and GND. A transmission protocol using software handshake (XON/XOFF) grants a baud-rate up to 19.2 kBaud.

SERIAL OUTPUT



4) D 9-pole female connector for pre and post filter AC analogue outputs (470 ohm impedance) and for a control output for the sound source used when measuring reverberation time (**HD 9019 only**).

ANALOG OUTPUT



MUTE: SOUND SOURCE CONTROL OUTPUT (See technical specifications).
VACRA: PRE-FILTER AC OUTPUT (See technical specifications).
VACPF: POST-FILTER AC OUTPUT (See technical specifications).

SOUND

The sound is a pressure change that can be perceived by the human ear. When, for example, these variations are due to climatic changes, they are too slow to be heard, but when they are very fast, as those resulting from drumming, they can be perceived by the human ear, and identified as sounds.
The number of pressure oscillations per second is called sound frequency, and is measured in cycles per second or Hertz (Hz). The human-perceptible frequency range goes from 20 Hz to 20 kHz.
The sound propagation speed in the air is 344 m/s.

1. Sound Pressure Level (SPL)
The faintest sound perceptible by the human ear is the sound corresponding to a change in the atmospheric pressure of one part out of 5 billions, that is a change of approximately 20 millionths Pascals ($20x10^{-6}$ Pa). Despite the slightness of this pressure variation, the human ear can stand one million times higher pressure changes.
To be able to work properly in such a wide range of values, it is much more convenient to use the

decibel scale (dB).
By this scale, the lowest pressure change ($20x10^{-6}$ Pa) corresponds to 0 dB. Every time this pressure change is increased by 10 times, 20 dB are added. In this way, for example, $2x10^{-4}$ Pa correspond to 20 dB, $2x10^{-3}$ Pa correspond to 40 dB and so on.
A 120 dB sound pressure level corresponds to one million times the minimum level perceptible to humans.

2. Sound Pressure Level Stability
If the sound level changes, the instrument should follow its variations, but when they are too fast, their instant measurement might not be achievable. In these cases, the instrument provides the measurement of the average value. To solve this problem, the sound level meter is provided with two response times called time weightings. They might be: FAST, used when you need to follow, as far as possible, noise fluctuations; and SLOW, used to damp noise fluctuations down and to detect the average value.
If the sound lasts for a very short time, that is less than one second, it is defined impulsive. For example, typing on a typewriter and the sound of a hammer or of a gun may be classified as impulsive sounds. To estimate the level of this type of sounds, consider that the briefer the sound is, the less sensitive the ear is in perceiving it. This is the reason why a time weighting has been defined, whose sensitivity decreases according to the sound duration time (IMPULSE).
The risk of injuries to hearing, however, does not decrease according to the sound duration time, thus, sound level meters generally incorporate a circuit suitable to measure the Peak level of the acoustic signal (PEAK).
Impulsive sounds, regardless of their spectrum, are more dangerous to the human ear, because the energy involved in the short time they last, does not allow the ear to take any defence. For this reason the duration of these sounds is penalized by increasing the detected sound pressure level by 3 dB to 5 dB.
A simplifying criterion to detect the presence of impulse noises, consists of detecting a difference of over 6 dB in measurements made with SLOW and IMPULSE constants on the same noise.

3. Sound Frequency Spectrum
Pure tones in noise can cause even worst injuries to hearing than wide band noise; the phenomenon is to be found in the concentration of energy in a more restricted zone (where pure tones operate at ear level), compared with the wide band noise zone.
The search for pure tones is carried out analysing the sound pressure level for octave or fraction octave bands. The frequency range of perceivable sounds, from 20 Hz to 20 kHz, is divided into bands: about 10 bands for octave filters and about 30 bands for 1/3 octave filters.
A pure tone is identified when, in a 1/3 octave band, the instrument detects a sound pressure minimum level (with FAST weighting) 5 dB higher than the minimum levels detected in the adjacent bands.

4. Equivalent continuous sound pressure level (Leq)
The danger represented by a noise also depends on exposure time. It is thus necessary to consi-

der how long it lasts. The sound level shall be continuously sampled throughout a known time interval to be able to calculate the Leq representing the level of constant noise that provides the same hearing risk as the variable noise level, during the same time.
HD 9019 and HD 9020 sound level meters are integrating sound level meters accurately measuring the equivalent level of impulsive short sounds.

INFLUENCE OF THE ENVIRONMENT

Temperature
HD 9019 and HD 9020 sound level meters are designed to work at temperatures included between -10°C and +50°C. However, it is advisable to avoid sudden changes, as they might cause condensate. Check also that instruments be in temperature equilibrium before executing a measurement or a calibration: to do so, just wait an hour after the instrument has been subjected to a temperature change.

Humidity
A relative humidity up to 90% has no effect on HD 9019, HD 9020 and on the microphone used in HD 9019S/1 probe. In any case, protect and clean the microphone from rain and snow. By unfavourable weather conditions, it is suggested to use a windscreen and, by highly humid environments, use the microphone proper dehumidifier.

Pressure
Atmospheric pressure changes within 10% do not actually affect HD 9019 and HD 9020 measurement accuracy.

Wind
To reduce wind disturbance, use the special windscreen, made up by a polyurethane foam porous sphere to be applied on the microphone.
It will also protect the microphone from dust, dirt and showers.

Vibrations
It is good practice to isolate instrument and microphone from vibrations.

Magnetic Fields
Electrostatic and magnetic fields actually do not affect HD 9019 and HD 9020 (just trivial effects).

PHYSICAL PARAMETERS IN ACOUSTICS

* **Frequency:** Frequency is the number of oscillations per second, and it is expressed in Hertz (Hz).

* **Period:** Period is the time interval it takes to carry out a complete oscillation. It is expressed in seconds (s).

* **Sound propagation speed:** is the distance made by the sound wavefront in the time unit, expressed in meters/second (m/s).

* **Wavelength:** is the distance between two pressure maximum values. It is expressed in meters (m).

* **Sound pressure:** is the value of the atmospheric pressure variation caused by acoustic disturbances. It is expressed in Pascal (Pa).

* **Root-mean-square value:** the root-mean-square value of sound pressure (p) is the value of constant pressure corresponding to the instant compression or rarefaction value integrated in the time interval T.

1) $$p\ (rms) = \sqrt{\frac{1}{T}\int_0^T p^2 \quad dt}$$

where: p (rms) is the sound pressure effective value.
T is the integration time.

* **RMS:** means “ROOT MEAN SQUARE”, square root of the average of square values. In noise measurements p(rms) corresponds to the square root of the arithmetic average of a sequence of noise instant values squared.
  - p(rms) is important in sound measurements as it depends on the amount of energy contained in the sound signal.

* **Crest factor:** is the ratio between the signal peak level and the signal effective value, measured with respect to the arithmetic average value.

* **Decibel:** a decibel (dB) is defined by:

2) $$dB = 20 \log_{10} \frac{X}{X_o}$$

where: x is the value of measured quantity.
x_0 is the measurement reference value (corresponding to dB=0).

The sound pressure level (SPL) is defined by the equation:

3) $$Lp = 10 \log_{10} \frac{P^2}{P_o^{\,2}} = 20 \log_{10} \frac{P}{P_o}$$

where: Lp = sound pressure level.
p = measured pressure level.
p_0 = reference pressure value = 0.00002 = $20 \cdot 10^{-6}$ Pascal.

*** Equivalent continuous sound pressure level (Leq):** defined as

4) $$Leq,T = 10 \cdot \log_{10} \left\{ \left(\frac{1}{T} \int_{t_1}^{t_2} P^2 \, dt \right) \Big/ P_o^{\,2} \right\}$$

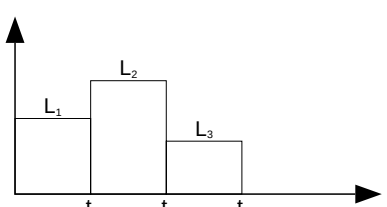
where: Leq,T is the equivalent continuous sound pressure level in a $T=t_2-t_1$ time interval.
p is the instantaneous sound pressure.
p_0 is the reference pressure level corresponding to $20 \cdot 10^{-6}$ Pa.

- Total Leq calculation from partial Leq measurements

If you need to know the total Leq after measuring partial Leqs, use the following formula:

$$Leq = 10 \log \sum_i^n \frac{T_i}{T} 10^{Leq\ i/10} \text{ con } T = \sum_i^n T_i$$

Example:
Suppose you have measured:
Leq_1 = 80 dB in 1 h.
Leq_2 = 90 dB in 2 h.
Leq_3 = 50 dB in 5 h.



$$Leq = 10 \log \left[\frac{t1\ 10^{Leq1/10} + t2\ 10^{Leq2/10} + t3\ 10^{Leq3/10}}{t1+t2+t3} \right]$$

Leq_1, Leq_2, Leq_3	partial equivalent levels.
t_1, t_2, t_3	equivalent levels integration times.
LeqT	total equivalent level.

Thus T= 1 h + 2 h + 5 h = 8 h.
Getting:

$$Leq = 10 \log \left(\frac{1}{8} 10^{8} + \frac{2}{8} 10^{9} + \frac{5}{8} 10^{5} \right) = 84.2 \text{ dB}$$

*** Sound Exposure Level (SEL):** defined as

5) $$Le,T = 10 \cdot \log_{10} \left\{ \left(\int_{t_1}^{t_2} P^2 \, dt \right) \Big/ \left(P_o^2 \cdot T_o \right) \right\}$$

dove: Le,t is the sound exposure level measured in a $T=t_2-t_1$ time interval.
p_0 corresponds to $20 \cdot 10^{-6}$ Pa.
T_0 corresponds to 1 s.

Between Leq and SEL the following relation applies:

6) $$Le,T = Leq,T + 10 \log_{10} \frac{T}{T_o} \text{ dB}$$

*** Percentile Levels**

- LN “percentile levels” are used in the statistical analysis of noise events, especially if fluctuating. These values correspond to the noise levels exceeded during a percentage N of the total measurement time.
- For example, L10 corresponds to the noise level exceeded by 10% of the measurement time.

- For example in vehicle traffic noise measurement, the “Traffic Noise Index” is defined as:

$$TNI = 4 (L_{10} - L_{90}) + L_{90} - 30$$

*** Dose**

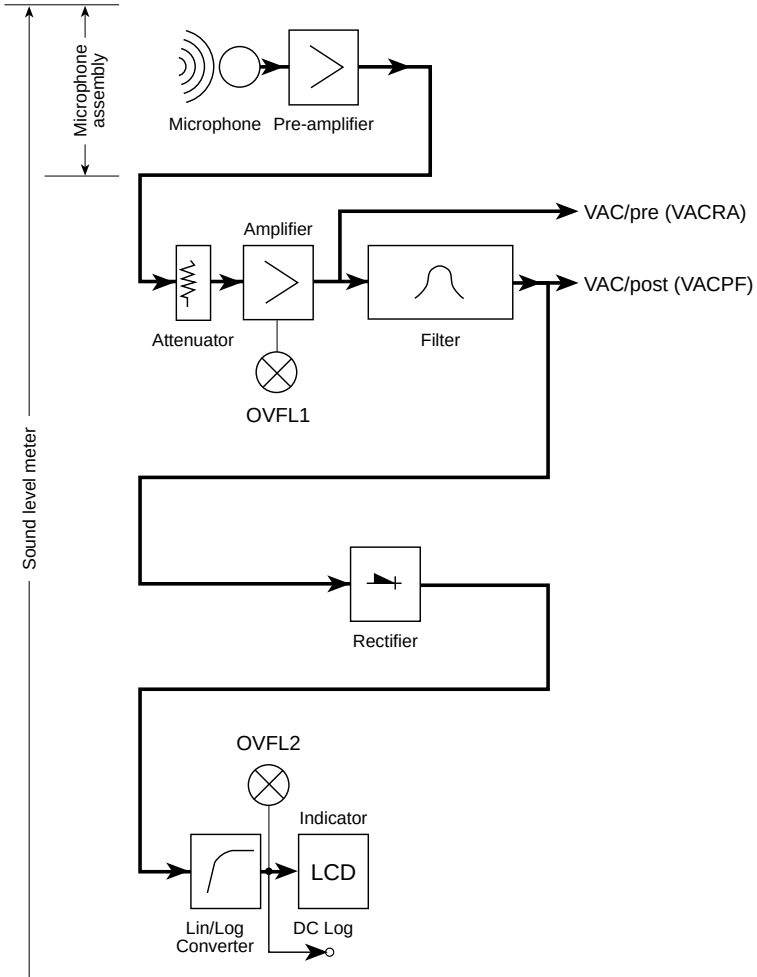
- The measurement of noise “Dose” is applied in the field of environmental noise monitoring with the aim to prevent hearing injuries. A “Dose” corresponds to a percentage fraction of a maximum daily exposure to noise:

$$D(Q) = \frac{100}{T_c} \cdot \int_0^T 10^{\frac{L - L_c}{q}} \, dt$$

where: D(Q) exposure percentage corresponding to exchange rate Q.
T_c daily exposure time (usually 8 hours).
T measurement time.
L sound pressure level when higher than the threshold level or $-\infty$.
L_c criterion level for a daily exposure corresponding to 100% of dose.
Q exchange rate.
q parameter dependent on the exchange rate and corresponding to:
- 10 for Q = 3 dB
- 5/log2 for Q = 5 dB
- 4/log2 for Q = 4 dB

SOUND LEVEL METER BLOCK DIAGRAM

The acoustic signal is transformed by the microphone into an electrical signal and amplified by the Pre-amplifier block integrated in the probe.
The amplified signal enters the instrument passing first through an attenuator and then through an amplifier provided with an overload indicator (OVFL 1), and then it enters the frequency weighting area, made up by a filter bank.
Before and after the frequency weighting, the signal is available at Vac/pre (VACRA) and Vac/Post (VACPF) outputs, respectively.
The signal then enters the rectifying, integration and logarithmic conversion block with overload indicator (OVFL 2), that provides the DC analogue output and the signal for the LCD display block.


Microphone assembly
Sound level meter
Microphone
Pre-amplifier
Amplifier
VAC/pre (VACRA)
VAC/post (VACPF)
Attenuator
Filter
OVFL1
Rectifier
OVFL2
Indicator
LCD
Lin/Log Converter
DC Log

HD 9019/S1 MICROPHONE AND PROBE

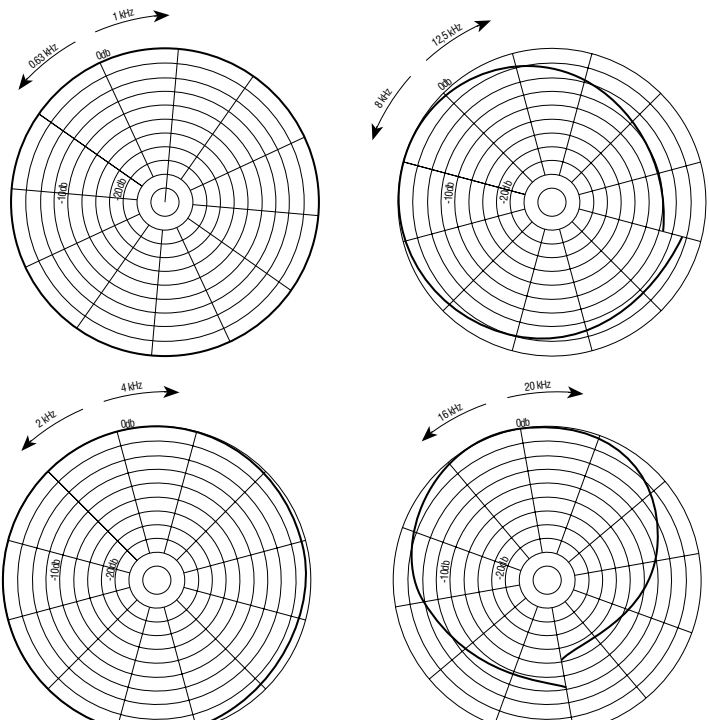
The sensitive element of a sound level meter is the microphone. The microphone is the element that converts the sound pressure into a proportional electrical signal.
The condenser microphone working principle is based on the microphone capacitance variation proportional to sound signal. Microphone peculiar specifications are:

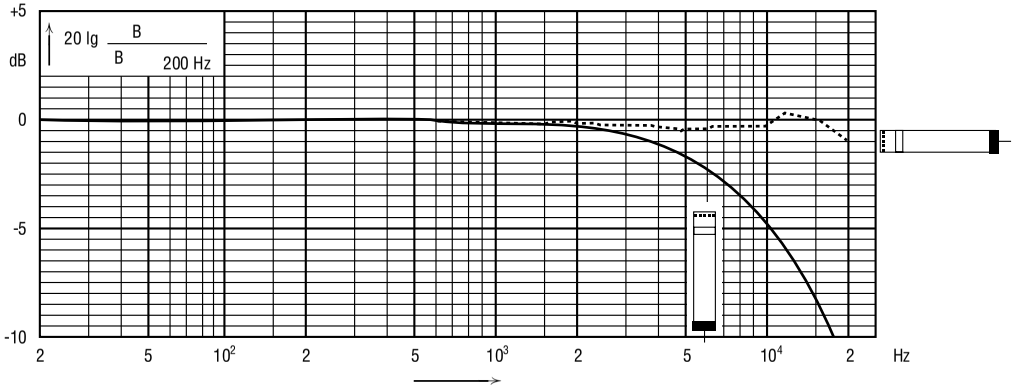
* Sensitivity: is the ratio between the effective level of open circuit output voltage and the input acoustic pressure.
* Frequency answer: corresponds to the microphone capacitance to perceive changes, at the different frequencies, of sound signals, and it is the result of the difference between the effective level of the open circuit output voltage at different frequencies referred to the level at 1kHz, measured with a constant input sound pressure level.
* Directionality: is measured by the microphone sensitivity variation with the sound pressure source direction.

HD 9019S/1 1/2" condenser microphone is suitable for **free-field** high-accuracy measurements (IEC 651, type 1). Carefully manufactured and made up by best-quality components grant this microphone long-lasting stability and accuracy.
The microphone diaphragm is protected by a removable external grid. As the diaphragm is **VERY THIN, AVOID TO TOUCH IT WITH FINGERS OR, EVEN WORST, WITH SHARPENED OR ROUGH OBJECTS,** to prevent damaging it.
Protect the diaphragm from vibrations or shocks, which might damage it.
HD 9019S/1 microphone sensitivity is approx. 50 mV/Pa, which means that it produces a 50 mV voltage by 1 Pascal sound pressure. Polarization voltage is 200 V. Maximum detectable level (by 3% distortion) is 146 dB.

Microphones with free-field response have a flat frequency response in a plane wave sound field. Furthermore, they are designed to compensate disturbance introduced into the sound field and caused by the microphone itself. In a free-field, the sound pressure level decreases by 6 dB doubling the distance from the source.
To carry out free-field measurements, point the free-field response microphone directly towards the

sound source.
The omni-directionality of a microphone is the capacity to regularly detect (with no attenuation with respect to its rated sensitivity) any sound pressure variation, whatever the sound source direction is. Actually, there is a sensitivity attenuation depending on the angle of incidence due to the microphone and instrument body. The following drawings show the typical response diagrams at different frequencies depending on the angle of the HD 9019S/1 condenser microphone with respect to the sound source.





Microphone capsule MK 221. Frequency response

INSTRUMENT WORKING

1. Power-on and Power-off

Press ON/OFF key to power the instrument on or off.

The AUTO POWER-OFF device switches the instrument automatically off if no key has been pressed for 8 minutes (except ON/OFF and RESET keys).

If upon power-on you keep the HOLD key pressed (**for the whole power-on routine**), the auto power-on function will be disabled and the instrument will turn off only pressing the ON/OFF key again. While working with auto power-off disabled, the battery symbol flashes to remind the user that he has to press ON/OFF to turn the instrument off.

Upon power-on, the instrument executes an internal check; the reading stabilization time is approx. 30 seconds.

If, upon power-on, and during the whole power-on routine, CAL and SERIAL OUTPUT keys are hold pressed, the instrument, after switching on, executes an initialisation of configuration and calibration parameters (general RESET), deleting all memories and then turns off. When switching it on again, the instrument will execute a memory check, lasting about 3 minutes and displaying the number of inspected blocks.

When the check is over, the instrument will switch on regularly, and, if a memory malfunction was detected, the FULL symbol will be displayed. After a general RESET, a calibration of the instrument must be carried out, before making any measurement.

2. Frequency Weightings

The measurement of the sound pressure level, as perceived by a person, aimed to measure its noise or the risk of hearing injuries, has involved world-wide the introduction of A, B, C and D frequency weighting curves.

The reason of these curves is due to the non-linear behaviour of the sound/noise sensation by the human ear.

The “A” filter is used to measure the hearing disturbance/injury or risk, and “D” filter to measure noise caused by the aircraft traffic.

When more detailed information about a complex sound signal are requested, the perceivable frequency range can be divided into different sections having an octave, or, even better, 1/3 octave amplitude.

When the division is by octave bands, the upper frequency of each octave is twice that of the previous one; an octave band is thus included between two frequencies, where the higher boundary is twice the lower one.

When the division is by 1/3 octave bands, each band is included between two frequencies, where the higher boundary is 1.26 (or exactly $2^{1/3}$) times the lower one. A filter bank executing this sound frequency division rejects all signals having frequencies out of the boundaries of the selected filter. For example, a 1/3 octave filter, with 1 kHz centre frequency, allows to measure sounds included between 891 Hz and 1123 Hz, attenuating all the others.

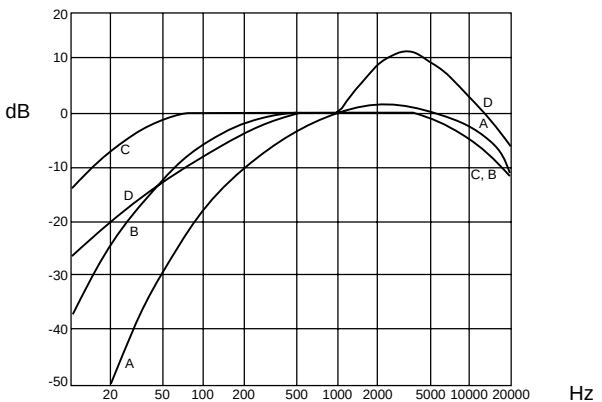
This sound measurement process providing different frequency bands is named “frequency analysis” (see Progr. 2), whose results can be collected and represented in a histogram.

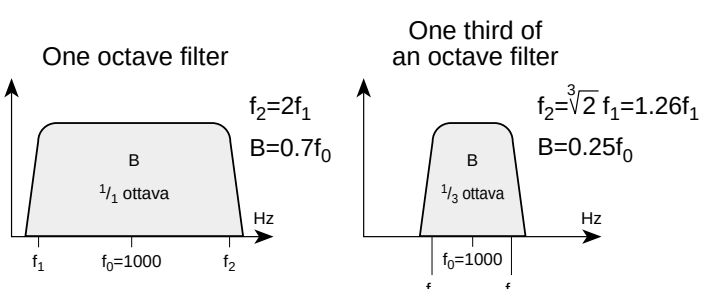
Sometimes, some kinds of noises are distinguished by a particular sound power frequency spec-

trum. A “white noise” means that the sound power is constant over the perceivable frequency range or, at least, over the range of frequencies characterizing the noise itself. A “pink noise” means that the acoustic power is inversely proportional to frequency in a known range.

HD 9019 and HD 9020 execute measurements with A, B, C, D (**HD 9019 only**) weighting filters, all type 1 according to IEC 651 standard; with LIN (linear 16 Hz, 16 kHz) and with 1/3 octave bands from 16 Hz to 20 kHz, type 2 according to IEC 1260 standard.

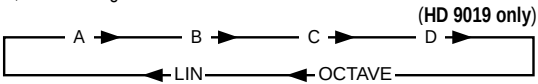
The diagram below indicates the typical frequency response of A, B, C and D filters.





Pressing POND, the following filters are selected in succession:

(**HD 9019 only**)



Pressing OCT, the display shows the value of the filter centre frequency expressed in kHz. Use ▲ and ▼ keys to select the desired 1/3 octave filter.

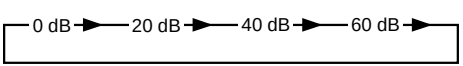
One-third octave band nominal frequencies are 32:

Pos.	Low Limit	Nominal frequency (Hz)	High Limit	Pos.	Low Limit	Nominal frequency (Hz)	High Limit
1	14.1	16	18	17	560	630	710
2	18	20	22.4	18	710	800	900
3	22.4	25	28	19	900	1.000	1.120
4	28	31.5	35.5	20	1.120	1.250	1.400
5	35.5	40	45	21	1.400	1.600	1.800
6	45	50	56	22	1.800	2.000	2.240
7	56	63	71	23	2.240	2.500	2.800
8	71	80	90	24	2.800	3.150	3.550
9	90	100	112	25	3.550	4.000	4.500
10	112	125	140	26	4.500	5.000	5.600
11	140	160	180	27	5.600	6.300	7.100
12	180	200	224	28	7.100	8.000	9.000
13	224	250	280	29	9.000	10.000	11.200
14	280	315	355	30	11.200	12.500	14.000
15	355	400	450	31	14.000	16.000	18.000
16	450	500	560	32	18.000	20.000	22.400

The use of OCTAVE weighting increases by approximately 35% the instrument power consumption, thus, when 1/3 octave filters are not necessary, it is much more convenient to choose another weighting. This allows to better exploit battery life.

3. Amplifier Gain

The instrument input amplifier has a 1÷1,000 programmable gain (from 0 dB to 60 dB).
The selection of the most suitable gain is carried out manually by increments of 20 dB.
Pressing RNG, the display shows the relevant symbol and the value expressed in decibel of current amplification. Use ▲ and ▼ keys to select the most suitable amplification for the measurement range; a red LED indicates the selected value.



If during the reading with a given amplification, the input signal level goes too high, **OVFL** will appear on display to indicate that a signal overload has occurred in the amplifier. Press RESET to delete the overload indication. If the symbol lights up frequently, a lower amplifier gain should be selected. Similarly, when measured level goes too low, the instrument will display the measured value and the **UF** (underflow) symbol alternatively. In this case, the amplification should be increased.
To every amplifier gain corresponds a measurement input level range, within which the instrument maintains its accuracy specifications. HD 9019S/1 measurement ranges are:

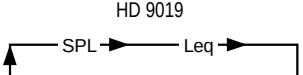
Range	sound pressure level measurement range
0 dB	140÷80 dB
20 dB	120÷60 dB
40 dB	100÷40 dB
60 dB	80÷20 dB

The boundaries of the Peak level measurement ranges are 3 dB higher than the listed ones.

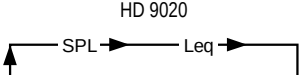
The minimum SPL measurable in the most sensitive range (with a 60 dB gain), is affected and limited by the background noise of the instrument, depending on the selected frequency weighting (see the "Technical Specification" paragraph).

4. Measurement Channels
HD 9019 and HD 9020 can measure simultaneously several quantities combined with the sound pressure level. During the Leq integration time, the instrument can detect simultaneously the weighted sound pressure level (SPL) by selecting between FAST, SLOW or IMPULSE and the relevant maximum and minimum values. Actually, if you press RESET, SPL maximum and minimum values are cleared, while Leq, SEL and Dose values are initialised (**HD 9019 only**).
If you press CHN repeatedly, one of the following measurement channels will be displayed:

HD 9019

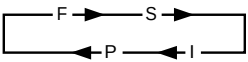


HD 9020



4.1 Sound Pressure Level (SPL)

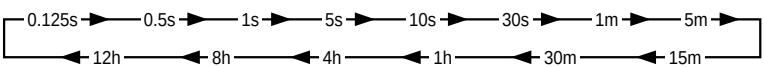
The SPL can have a SLOW, FAST, IMPULSE or PEAK weighting (selectable using the SPL CONST key). The symbol (S, F, I or P) corresponding to the selected weighting time lights up on the right side of display.



The instrument automatically updates SPL minimum and maximum values. When the SPL channel is displayed, if you press the MAX/MIN key repeatedly, maximum (MAX), minimum (MIN) and current values will be displayed.
Press RESET to clear minimum and maximum values.
Leq, SEL, Dose (**HD 9019 only**) and SPL minimum and maximum values are calculated simultaneously with the current value of the sound pressure level. Only during the measurement of the Peak level (PEAK) no other measurement is available.

4.2 Equivalent Continuous Sound Pressure Level (Leq) and Sound Exposure Level (SEL)

The Leq, or equivalent continuous sound pressure level, is calculated integrating the sound level with the time.
Leq and SEL are calculated starting when you press RESET, and are integrated for a time corresponding to the programmed value. To set this value, press LEQ TIME and use ▲ and ▼ keys:



When you press RESET, Leq and SEL calculation starts, and their current values can be displayed pressing CHN until the respective symbol (LEQ or SEL) lights up. The update of displayed value is over when programmed integration time has been reached.
Current integration time can be read pressing ▲ (h.m) for hours and minutes. Numbers on the left side of the point indicate the elapsed hours, while the other two numbers correspond to the elapsed minutes. Press ▼ (s) key to read seconds.
If you press HOLD, Leq update can be temporarily interrupted; for example, to exclude unwanted noise events from integration. Pressing HOLD again, the integration resumes.

*4.3 Dose (**HD 9019 only**)*

As for the Leq calculation, 8 h DOSE (that is the 8-hour estimated dose for an exposure at current levels) and DOSE are calculated starting from the moment when RESET is pressed, and integrated for a time corresponding to the programmed LEQ TIME value.
THR, EXCH and CRIT parameters are used for the calculation, respectively: Threshold Level (Leq

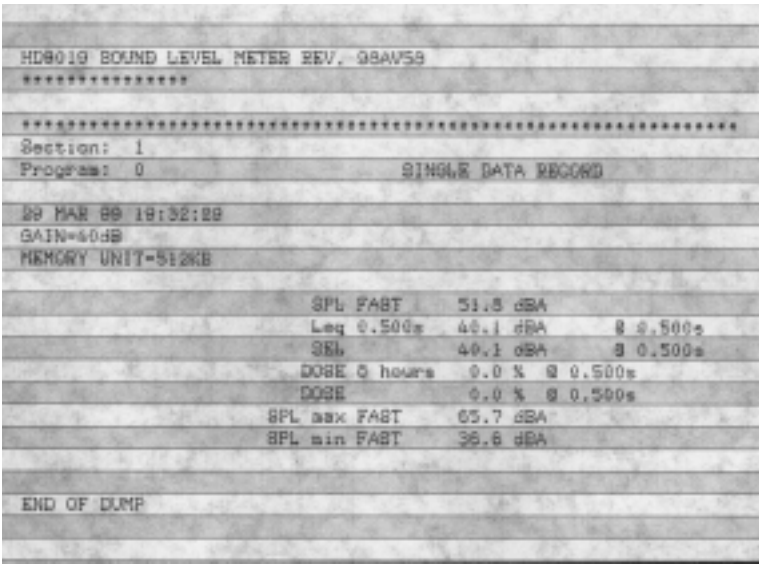
minimum value considered), Exchange Rate (selectable among 3 dB, 4 dB and 5 dB) and Criterion Level (reference level for a 100% daily exposure).
Sound pressure levels lower than the Threshold Level are not considered in the dose calculation.
An equivalent level corresponding to the Criterion Level, throughout an 8-hour integration time, provides a 100% dose.
An equivalent level equal to the Criterion Level, decreased by the Exchange Rate, provides a 50% dose over an 8-hour integration time.
An equivalent level equal to the Criterion Level, increased by the Exchange Rate, provides a 200% dose over an 8-hour integration time.
As for Leq, dose update can be temporarily interrupted pressing HOLD, and pressing HOLD another time the calculation resumes.
Dose calculation stops when the programmed integration time is reached. Press RESET to execute a new measurement.

5. Direct Printing

Pressing SERIAL OUT, the instrument sends, through the RS-232C serial interface, the displayed value directly to a printer or to a personal computer. Pressing SERIAL OUT while any of the sound level meter parameter is displayed (see Parameters), the instrument sends the current values of all parameters. Pressing SERIAL OUT while setting the amplifier gain (RNG), the instrument sends the following information:
• sound level meter model and relative revision number;
• date and time;
• input amplifier current gain;
• equipped memory size.

6. Storage

HD 9019 and HD 9020are provided with a 512 kByte memory bank for measurement storage.
All measured and calculated data (in a known instant) can be written to memory simply pressing the STORE key when the PROG symbol is not light up on display (“Single data record”).
The memory is organized in sequences and every data record is preceded by a header including time and date in addition to all other parameters that might be useful to identify the measurement conditions.
1, 2 and 4 (**HD 9019 only**) programs automatically store, by preset time intervals, Leq measured values, while program 6 allows stored data downloading directly to a printer or to a personal computer.
Memory capacity grants:
• 5000 “Single data record” (STORE);
• 9 hours of “Leq history and statistics” (PROG 1) at a 1/8 second integration time;
• 5000 “Frequency spectrum” (PROG 2) frequency analysis;
• 50 “Reverberation time calculation” (PROG 4) (**HD 9019 only**).

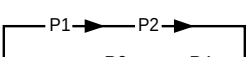

HD9019 SOUND LEVEL METER REV. 98AV59
Section: 1
Program: 0
SINGLE DATA RECORD
29 MAR 00 10:32:20
GAIN=60dB
MEMORY UNIT=512KB
SPL FAST 51.5 dBA
Leq 0.500s 40.1 dBA @ 0.500s
SEL 40.1 dBA @ 0.500s
DOSE 0 hours 0.0 % @ 0.500s
DOSE 0.0 % @ 0.500s
SPL max FAST 65.7 dBA
SPL min FAST 36.6 dBA
END OF DUMP

7. Programs

HD 9019 and HD 9020 sound level meters are provided with automatic storage of measured Leq values.

Pressing PROG repeatedly, you can select one of the following parameters:

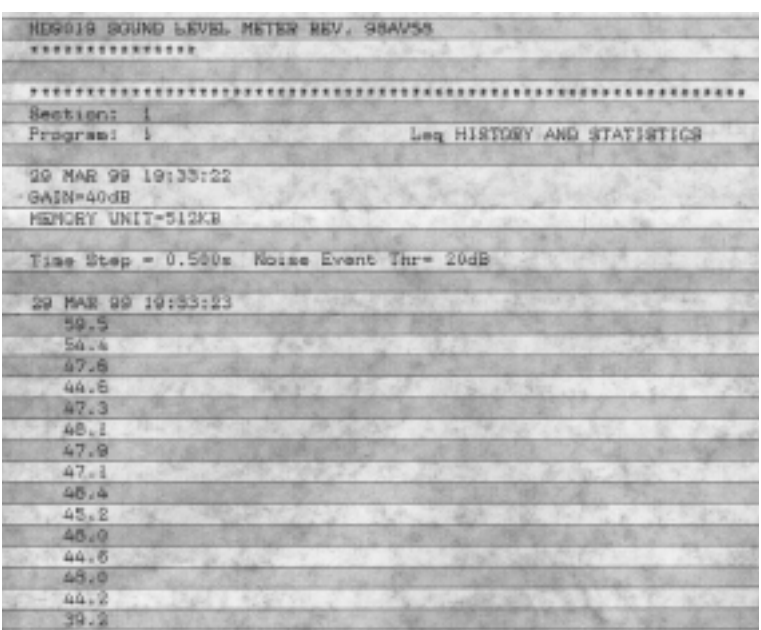
Prog 1: Leq history and statistics.
Prog 2: Frequency spectrum.
Prog 4: Reverberation time calculation (**HD 9019 only**).
Prog 6: Memory dump.



The selected program is activated or stopped by pressing START/STOP. When the program is running, the PROG symbol flashes.

If, to start the program, Serial Out is pressed instead of Start, measurements are sent directly to the serial output and not to the instrument memory.

Program 1 stores a Leq sequence. Leq first is integrated for the programmed time (LEQ TIME), then it is compared with the programmed threshold (THR MIN) and, if the value exceeds the threshold level, the Leq is stored.
The integrations, of duration corresponding to the programmed value (LEQ TIME), follow one another cyclically and without interruptions until the STOP key is pressed.
When you press STOP, Leq history storage stops and the instrument processes the statistical analysis of the measurements, calculating **L10, L50** and **L90** percentile levels. **L10** is the first value displayed. Pressing STOP again, **L50** will be displayed, while **L90** appears if STOP is pressed for the third time.
Press STOP once more to quit the program.
The statistical analysis can be stored alone by pressing ▲ before and contemporaneously with START.
If you press Serial Out instead of START, the program header is first sent to the serial link and, at the end of the measurement sequence, pressing STOP **L10, L50** and **L90** percentile levels are printed. Press STOP three more times to exit the program.



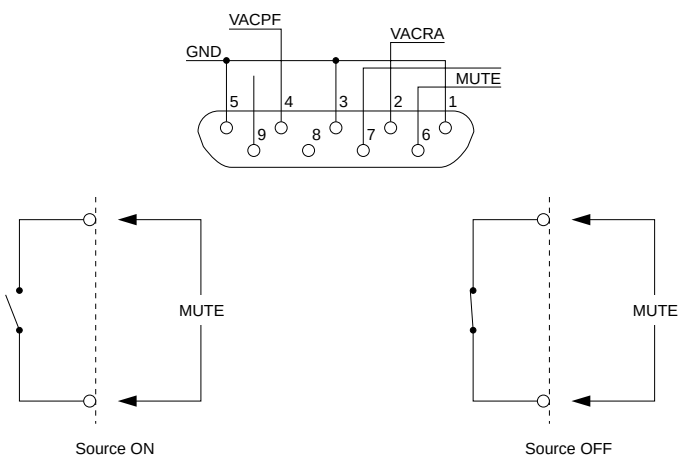
```
Leq     p  !00      !      !10      !      !20      !      !30
dB      %  !        !      !        !      !        !      !
  39   6.7 !**********
  41   0.0 !
  43   0.0 !
  45  20.7 !********************************************
  47  28.7 !************************************************
  49  20.7 !********************************************
  51   0.0 !
  53   0.0 !
  55   6.7 !**********
  57   0.0 !
  59   6.7 !**********
  61   0.0 !
  63   0.0 !
  65   0.0 !
  67   0.0 !
  69   0.0 !
  71   0.0 !
  73   0.0 !
  75   0.0 !
  77   0.0 !
  79   0.0 !
  81   0.0 !
  83   0.0 !
  85   0.0 !
  87   0.0 !
  89   0.0 !
  91   0.0 !
  93   0.0 !
  95   0.0 !
  97   0.0 !
  99   0.0 !
 101   0.0 !
 103   0.0 !
 105   0.0 !


L90= 44.2dB
L50= 47.3dB
L10= 55.0dB


END OF DUMP
```

Program 2 stores one 5-second Leq for each 1/3 octave band in automatic scanning from 16 Hz to 20 kHz.
The program automatically stops when scanning is over. Press STOP if you need to interrupt it before.
If you press SERIAL OUT instead of START, the program header and the measured values will be sent directly to the serial link.

```
MB9019 SOUND LEVEL METER REV. 98AV55
****************

**********************************************************************
Section:  1
Program:  2                          FREQUENCY SPECTRUM ANALYSIS

29 MAR 99 19:34:49
GAIN=40dB
MEMORY UNIT=512KB

Time Step =     5s

FREQ     Leq   130      :      150      :      170      :      190
 Hz      dB    :        :      :        :      :        :      :
16.0     50.7 |******************
20.0     46.6 |****************
25.0     58.9 |************************
31.5     49.9 |******************
40.0     41.5 |***********
50.0     46.6 |****************
63.0     53.1 |**********************
80.0     49.9 |******************
 100     47.7 |*****************
 125     42.3 |***********
 160     44.0 |*************
 200     44.4 |*************
 250     38.5 |********
 315     49.2 |******************
 400     35.8 |*****
 500     52.1 |**********************
 630     39.5 |*********
 800     40.0 |**********
1.00 k   34.3 |****
1.25 k   30.0 |*
1.60 k   33.3 |***
2.00 k   25.7 |
2.50 k   26.0 |
3.15 k   25.6 |
4.00 k   27.9 |
5.00 k   27.9 |
6.30 k   26.5 |
8.00 k   20.7 |
10.0 k   21.3 |
```

Program 4 (HD 9019 only) is used to calculate the reverberation time both with the technique of sound source interruption and with the integrated impulsive response technique.
In the first case, it is necessary to control the source through the HD 9019 sound level meter MUTE output (see Connectors): the source shall be on with MUTE output open, and off with MUTE output closed.

ANALOG OUTPUT



In case of measurement with interruption of the sound source, the Event Threshold parameter (THR MIN) shall be set at a value lower than the source-generated noise, which shall exceed the background noise by 40 dB, at least.
Pressing START, the HD 9019 sound level meter will suddenly interrupt the sound source by switching the MUTE output and the Leq values (integrated for 1.25 ms) are stored 800 times/second.
Sampling will stop as soon as the Leq drops 35 dB below the starting level, or as soon as 5 s have elapsed.

T10, T20 and T30 values will now be stored and calculated evaluating the reverberation time (60 dB drop) from the difference between the instant when the Leq went 5 dB below the starting level and 15 dB, 25 dB and 35 dB below such a level, respectively.

In case of measurement through the integrated impulsive response, set Event Threshold (THR MIN) at a value higher than the background noise, as closest as possible to the maximum level reached by the impulsive source signal, without exceeding it.
After pressing START, the instrument waits for the measured Leq to exceed the Event Threshold (THR MIN). When the threshold is exceeded, the Leq values (integrated for 1.25 ms) are stored 800 times/second.
Sampling will interrupt as soon as the Leq drops 35 dB below the maximum reached level, or when 5 s have elapsed since threshold was exceeded.
T10, T20 and T30 values will now be stored, calculated evaluating the reverberation time from the differences between the instant the Leq went 5 dB below the starting level and 15 dB, 25 dB and 35 dB below such a level, respectively.

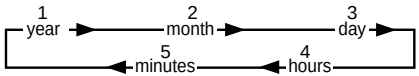
If you press STOP, or if the reverberation time calculation is over, or if more than 5 s have elapsed since the beginning, T10 value will be displayed. Press STOP again to display T20, while T30 will appear pressing STOP for the third time. Press STOP once more to quit the program.
Keep ▲ pressed (contemporaneously with START) to store T10, T20 and T30 values only.

To measure reverberation time, position the sound source and the sound level meter far from walls and reflecting surfaces, as well as far one from the other. Measurements shall be executed using the 1/3 octave filters and they have to be repeated for several centre frequencies.

Program 6 allows downloading HD 9019 and HD 9020 stored data, directly to a printer or to a personal computer using the RS-232C link.
Pressing START the display shows P6 and all stored measurements are downloaded through the RS-232C serial link (memory dump); the program will automatically stop. If you need to interrupt it before, press STOP. Press and hold pressed the ▲ key while pressing START to download only stored data headers.
No memory reset is automatically carried out after executing program 6.
While PROG 6 is displayed, press RESET to clear the memory contents.
If memory has been accidentally zeroed, you can restore data keeping the ▼ key pressed contemporaneously with START.

8. Calendar

The calendar clock can be programmed using DATE, ▲ and ▼ keys. If you press DATE repeatedly, you can select:



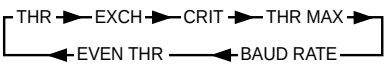
Using ▲ and ▼ keys, displayed values can be increased or decreased, until the correct date and time settings are achieved.

The calendar updates also while the instrument is off and **has to be readjusted or checked every time you replace batteries.**

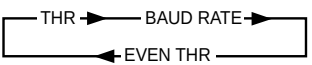
9. Parameters

Press PAR repeatedly to select the following parameters:

HD 9019

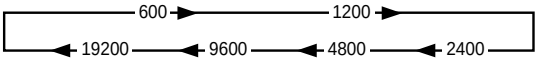


HD 9020



- "Threshold Level", "Exchange Rate" and "Criterion Level" (respectively displayed as THR, EXCH and CRIT) are used in the DOSE calculation (**HD 9019 only**).
  - "Threshold Level" is the SPL threshold for DOSE calculation. The value can be programmed in the 0 dB ÷ 90 dB range with increments of 5 dB.
  - "Exchange Rate" is the SPL decrement that doubles the exposure time for the same dose at a given "Criterion Level". This value can be selected among 3 dB, 4 dB and 5 dB.

  - The "Criterion Level" is the constant SPL providing a 100% dose for an exposure of 8 hours. The value can be programmed in the 0 dB ÷ 150 dB range, with increments of 1 dB.
- Threshold MAX (THR MAX) is the Leq threshold for the OVFL overload symbol activation. The value can be programmed in the 0 dB ÷ 150 dB range, with increments of 1 dB.
- Baud Rate establishes the RS-232C serial link baud-rate, selectable among:



- Event Threshold (THR MIN) is the threshold of the noise event used in program 1 and 4; the instrument waits for the Leq to exceed this value to make its calculations and possible storages: **WHEN Leq IS BELOW THIS VALUE, NO STORAGE IS CARRIED OUT.** The value can be programmed in the 0 dB ÷ 150 dB range with increments by 1 dB.

10. Sound Level Meter Calibration

The instrument, according to the standards in force, has to be calibrated to provide correct measurements.

Instruments that provide an accurate sound pressure level directly on the instrument microphone are generally used for the calibration. The most common are pistonphones and electronic calibrators.

HD 9019 and HD 9020 have to be preferably calibrated at 1kHz reference frequency and at 94 dB reference sound pressure level. A calibration at 250 Hz is possible too.

The HD 9101 calibrator provides a 94 dB sound pressure level at 1000 Hz frequency.

The HD 9101 calibrator specifications correspond to type 1, according to IEC 942 standard (IEC 60942/1997).

Calibration is generally checked before and after a measurement set. The measurements will be considered valid if the difference between the two verifications is lower than 0.5 dB.

To calibrate the instrument, insert the microphone in the calibrator seat.

BOTH THE CALIBRATOR AND THE INSTRUMENT SHALL BE OFF. Inserting the microphone involves a slight stress caused by the gasket of the calibration chamber. It is suggested to position the instrument and the calibrator on the same plane, at the same level, aligning the axis.

Press ON/OFF on the calibrator and select 94 dB sound pressure level (at 1000 Hz frequency).
Press ON/OFF on the sound level meter, wait until calibrator and sound level meter are stable (approx. 60 seconds).

Here are calibration instructions:
- Select the input amplifier gain (RNG), corresponding to 20 dB.
- Press CAL keeping SERIAL OUT pressed: PROG 5 will be displayed.
- Press ▲ o ▼ to adjust the displayed value and select 94 dB correct value (no correction has to be applied to calibrate the MK221 microphone for free-field measurements).
- Be sure reading is stable.
- Press CAL: the instrument will now automatically execute the calibration procedure in 10 steps (9 steps for HD 9020).
- A long "beep" at the end indicates that calibration has been carried out successfully.
- **If during this procedure the instrument quits the calibration function without emitting any sound, check whether the calibrator generates a correct signal and whether the amplifier gain (RNG) is properly set.**
- If the procedure interrupts, repeat the calibration operation starting from the beginning.

You can calibrate the instrument at sound pressure levels higher than 94 dB. For levels higher than 114 dB, you shall use a 0 dB input amplifier gain.

Calibration is a very important function and it has to be carried out very carefully and meticulously.

After calibrating, press ON/OFF to switch off both the calibrator and the sound level meter and take the microphone out the calibrator seat. The sound level meter is now calibrated.

Often you might simply have to check that the sound level meter properly reads the level generated by the calibrator. In this case you just have to:
• insert the microphone in the calibrator seat;
• turn the calibrator and the sound level meter on;
• set 94 dB on the calibrator;
• set RNG at 20 dB on the sound level meter;
• set the sound level meter at SPL channel constant SLOW and weighting “A”.
Now, when reading is steady (wait approx. 1 minute), check that the value read by the sound level meter corresponds to 94 dB with a 0.3/0.5 dB maximum error. If the difference exceeds these limits, the sound level meter needs to be calibrated according to the procedure described above.

11. Windscreen
Noise measurements in open spaces might be affected by the wind. To attenuate the wind pressure on the diaphragm, the microphone can be protected by a spherical cover made of open-pored polyurethane foam (HD SAV).

12. Measurement on Tripod
When measuring noise, pay attention that the operator’s body, the instrument case or its support could spoil the measurement.
Keep the instrument as far as possible from the operator’s body, and eventually fix it on a tripod to minimize the impact on noise measurements.

13. Low Battery Signal

HD 9019 and HD 9020 instruments are powered by 4 x 1.5 V R6-AA-UM3 alkaline batteries. If battery voltage drops below 1 V, the battery symbol will be displayed. This signal indicates to the operator that batteries are low and that they will provide only one more hour operating.

It is suggested to use best quality batteries. Do not leave exhausted batteries around, but through them into proper containers.

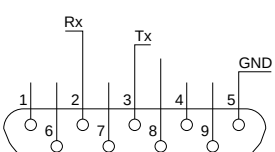
If the instrument is not used for a long time, take batteries off their seat to avoid damages due to corrosive liquid leakage.

NOTE: the flashing battery symbol does not indicate that batteries are low, but just that the auto power-off function is disabled.

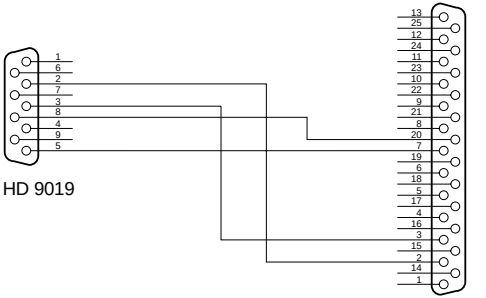
14. Remote Control

The instrument is provided with a bi-directional RS-232C serial interface.

SERIAL OUTPUT



600, 1200, 2400, 4800,
9600, 19200 BAUD
8 BIT DATA LENGTH
1 START BIT
1 STOP BIT
NO PARITY
XON/XOFF



HD 9019

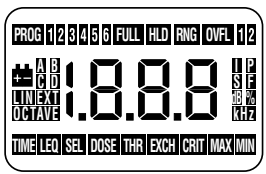
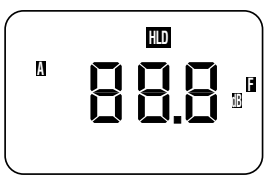
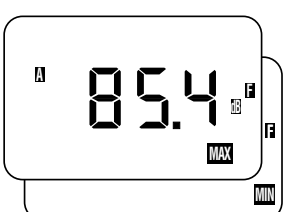
COMPUTER

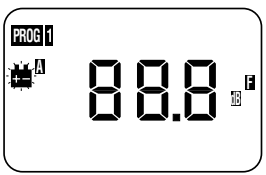
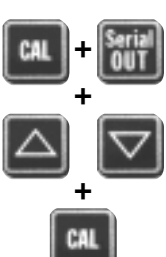
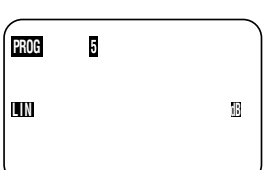
Except upon power-on and power-off, the instrument can be controlled via the RS-232C. Command ASCII codes are listed in the following table.

ASCII Codes

character	command	character	command	character	command
0	hold	630	octave=16 kHz	C0	prog=0
10	current value	631	octave=20 kHz	C1	prog=1
11	max value	70	range=0 dB	C2	prog=2
12	min value	71	range=20 dB	C4	prog=4 (**HD 9019 only**)
2	serial out	72	range=40 dB	C6	prog=6
3	reset	73	range=60 dB	D<val>	val dB=thr val 2 digits
40	pond=LIN	800	inttm=0.125 s		(**HD 9019 only**)
41	pond=A	801	inttm=0.5 s	E<val>	val dB=exch val 1 digit
42	pond=B	.			(**HD 9019 only**)
43	pond=C	.		F<val>	val dB=crit val 3 digits
44	pond=D	.			(**HD 9019 only**)
	(**HD 9019 only**)	812	inttm=8 h	G<val>	thrmax=val val 3 digits
45	pond=OCTAVE	813	inttm=12 h	H0	baudrt=600
50	const=FAST	90	chn=SPL	H1	baudrt=1.2 k
51	const=SLOW	91	chn=Leq	H2	baudrt=2.4 k
52	const=IMPULSE	92	chn=SEL	H3	baudrt=4.8 k
53	const=PEAK	93	chn=Dose 8 h	H4	baudrt=9.6 k
600	octave=16 Hz		(**HD 9019 only**)	H5	baudrt=19.2 k
601	octave=20 Hz	94	chn=Dose	J<val>	val dB=evnthr val 3 digits
.			(**HD 9019 only**)	K	instrument general reset
.		L	start	AA	instrument identification
		M	start+Δ		

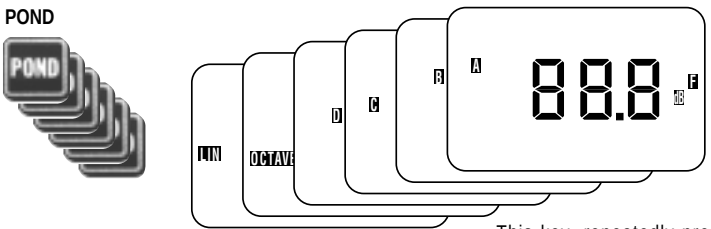
KEYBOARD FUNCTION

KEY	LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
ON/OFF 		Key to be used to power the instrument on and off.
HOLD 		Key to be used to interrupt display update or to stop the Leq integration. **If it is pressed contemporaneously with ON/ON/OFF and it is hold pressed for the whole power-on routine, it excludes the AUTO POWER-OFF function.** The battery symbol flashes.
MAX/MIN 		Key to be used to display the sound pressure level (SPL) MAXIMUM and MINIMUM values.
RESET 		- It zeroes the MAXIMUM and MINIMUM stored values. - It zeroes both Leq and overflow (OVFL 1 and 2 symbols). - It zeroes SEL and DOSE. - It zeroes the peak value. - It zeroes the memory contents if PROG 6 symbols are displayed (memory dump).

KEY	LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
SERIAL OUT 		Key to be used to enable the serial transmission of displayed channel. Every time this key is pressed the displayed value is sent to the serial link. - If 1, 2 or 4 programs are selected (PROG 1, 2 or 4 symbols lit), the program starts and enables serial data transmission, instead of data storage. Press STOP to interrupt the program (some programs request STOP to be pressed several times and not just once). PROG and the battery symbols flash. - If you are programming the amplifier gain (RNG symbol lit), it prints a header containing date and time with the main information concerning the type of probe, the internal memory size and the current amplifier gain. - While programming the parameters, all current values are printed.
CAL 		CAL. Key to be pressed while keeping SERIAL OUT pressed to start the calibration procedure (PROG 5 symbol lights-up). Press CAL to confirm the reference value and start the 10-step automatic procedure (**9 steps for HD 9020**).

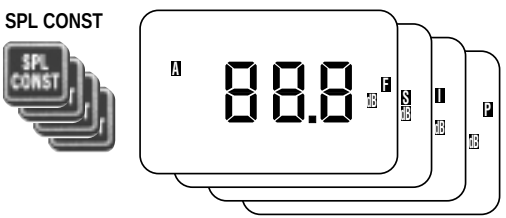
KEY	LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION

POND



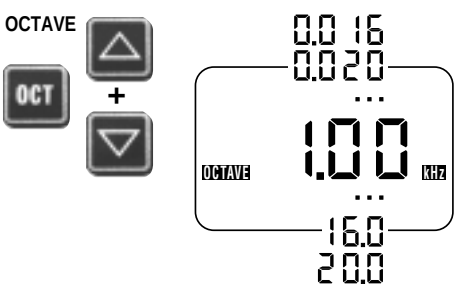
This key, repeatedly pressed, selects frequency weightings: A, B, C, D (**HD 9019 only**), OCTAVE, LIN.

SPL CONST



This key, repeatedly pressed, selects the time weightings for SPL measurement:
F = fast
S = slow
I = impulse
P = peak

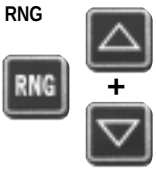
OCTAVE

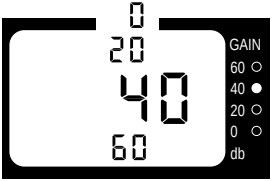


This key activates the selection of the 1/3 octave band filter centre frequency. The centre frequency can be adjusted through ▲ and ▼ keys.

KEY	LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION

RNG

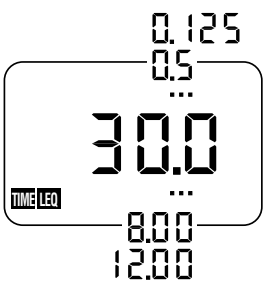




This key activates the selection of the input amplifier gain and, thus, the measurement range.
- Amplification is adjusted through ▲ and ▼ keys.

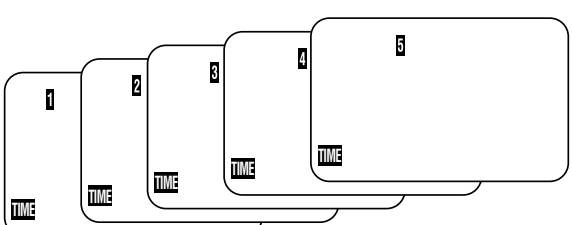
A red LED indicates the current amplifier value.

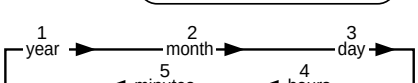
LEQ TIME



This key activates the selection of the Leq integration time in seconds, minutes and hours.
- The value can be adjusted through ▲ and ▼ keys.
- When you press this key, the Leq is zeroed and a new measurement is started.

DATE

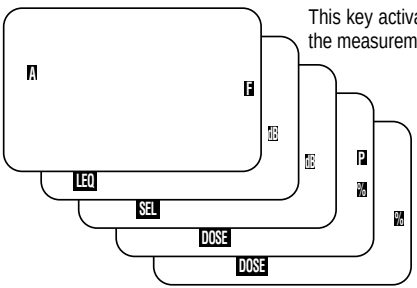




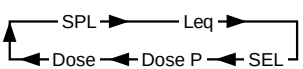
This key allows updating the calendar.
- If repeatedly pressed, year (1), month (2), day (3), hour (4) and minutes (5) values can be modified by means of ▲ and ▼ keys.

KEY	LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION

CHN

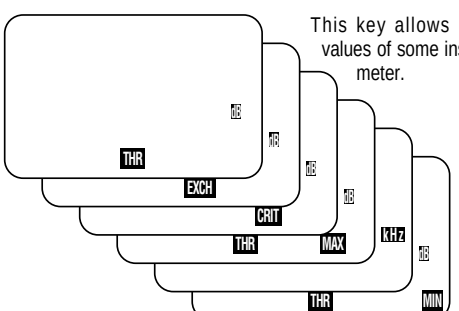


This key activates the selection of the measurement channel.

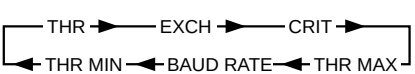


- If repeatedly pressed, it activates the following channels: SPL, Leq, SEL, DOSE 8-hours (**HD 9019 only**), DOSE (**HD 9019 only**).

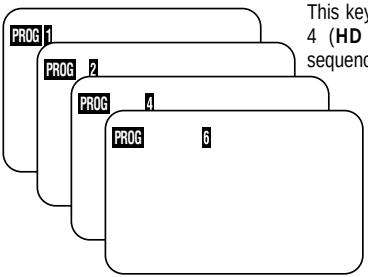
PAR



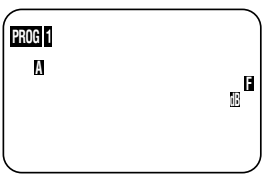
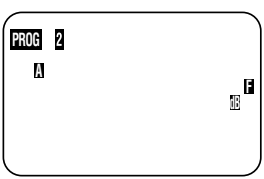
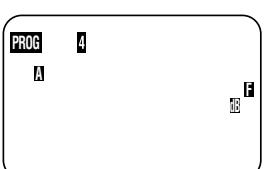
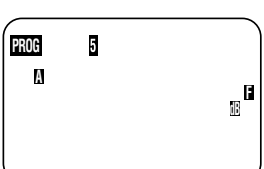
This key allows updating the values of some instrument parameter.

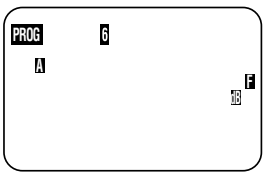
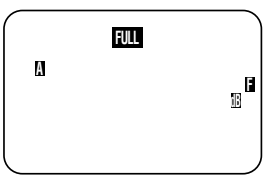
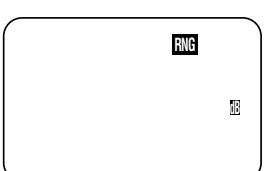
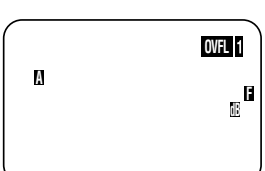


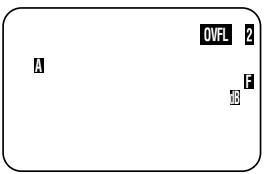
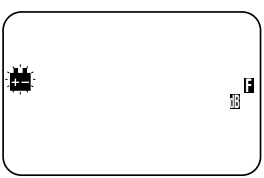
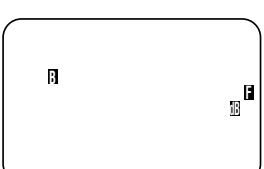
- If repeatedly pressed, it activates the following parameters:
- Threshold (**HD 9019 only**), Exchange Rate (**HD 9019 only**), Criterion Level (**HD 9019 only**), Threshold Max, Baud Rate and Event Threshold.

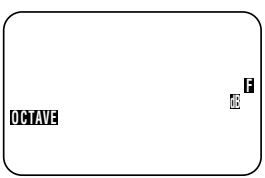
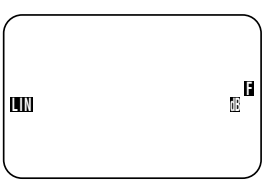
KEY	LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
PROG		This key activates programs 1, 2, 4 (**HD 9019 only**) and 6 in sequence.
		These keys allow changing the displayed value in many constant or parameter edit functions. - If ▲ is hold pressed, it displays Leq integration time HOURS and MINUTES. - If ▼ is hold pressed, it displays Leq integration time SECONDS.
START/STOP/ STORE		This key starts and stops programs 1, 2, 4 (**HD 9019 only**), and 6; when pressed with no program selected (PROG symbol off) all measurement channels are stored in a single data record (PROG 0 single data record).

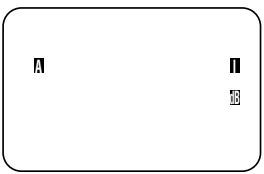
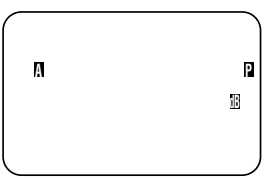
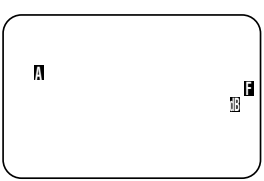
DISPLAY SYMBOL FUNCTION

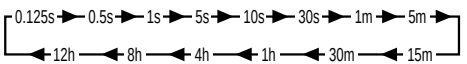
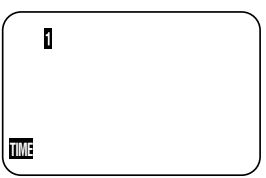
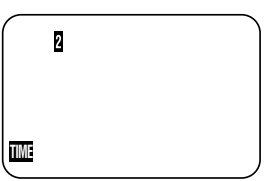
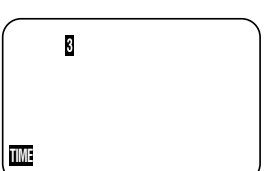
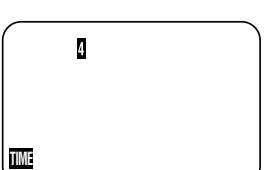
LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
	**PROG 1** This symbol appears when selecting program number 1: “Leq Monitoring and Statistical Analysis”.
	**PROG 2** This symbol appears when selecting program number 2: “1/3 Octave Band Automatic Scanning”.
	**PROG 4** This symbol appears when selecting program number 4: “Reverberation Time Measurement” (**HD 9019 only**).
	**PROG 5** This symbol appears when starting the instrument automatic calibration program.

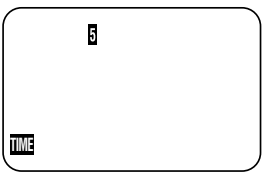
LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
	**PROG 6** This symbol appears when selecting program number 6 for memory dump via RS-232C.
	**FULL** This symbol appears when memory is full.
	HLD This symbol appears when the HOLD key is pressed (display update and Leq integration consequently suspended).
	**RNG** This symbol is lit while changing the input amplifier gain and selecting the measurement range.
	**OVFL 1** This symbol lights up when the instrument detects an overload on the input amplifier. The symbol remains lit until measurement conditions are not changed, such as measurement range, frequency weighting, etc., or until RESET is pressed starting a new measurement.

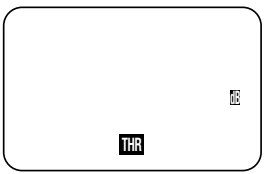
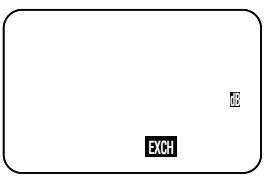
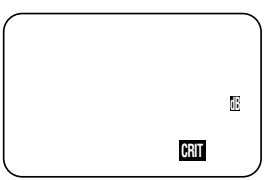
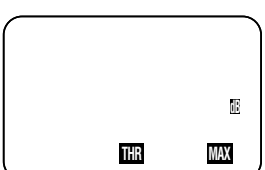
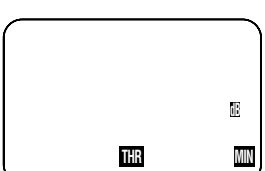
LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
	**OVFL 2** This symbol lights up when the instrument detects a converter overload, or when THR MAX programmed threshold has been exceeded. It is cleared pressing RESET.
	 This symbol flashes when the instrument auto power-off is disabled. If the symbol is always lit, it means that batteries are exhausted.
	A The symbols lights-up according to the selected frequency weighting.
	**B**
	C

LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
	D **Not available on HD 9020.**
	**OCTAVE**
	**LIN**
	F These symbols light up accordingly to the time weighting selected for SPL measurement: FAST,
	S SLOW,

LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
	**I** IMPULSE,
	**P** Peak.
	**dB** This symbol indicates that the displayed value is in decibels.
	% This symbol indicates that the displayed value is in % (**not available on HD 9020**).
	kHz This symbol indicates that the displayed value is in kHz (thousands of Hertz).

LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
	Leq TIME This symbol indicates that the displayed value is expressed either in seconds, minutes or hours. 
	**TIME 1** This symbol appears when updating the calendar to indicate that the displayed value is the year.
	**TIME 2** This symbol appears while updating the calendar to indicate that the displayed value is the month.
	**TIME 3** This symbol appears while updating the calendar to indicate that the displayed value is the day.
	**TIME 4** This symbol appears while updating the calendar to indicate that the displayed value is the hour.

LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
	**TIME 5** This symbol appears while updating the calendar to indicate that the displayed value corresponds to minutes.
	LEQ This symbol appears when **Leq** channel is displayed.
	SEL This symbol appears when SEL channel is displayed.
	DOSE P This symbol appears when **the 8-hour Dose** is displayed (**not available on HD 9020**).
	DOSE This symbol appears when the **current Dose** is displayed (**not available on HD 9020**).

LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
	**THR** This symbol appears when the **Threshold Level** parameter is being modified to calculate the Dose (**not available on HD 9020**).
	**EXCH** This symbols appears when the **Exchange Rate** parameter is being modified to calculate the Dose (**not available on HD 9020**).
	**CRIT** This symbol appears when the **Criterion Level** parameter is being modified to calculate the Dose (**not available on HD 9020**).
	**THR MAX** This symbol appears when the **THRESHOLD MAX** parameter is being modified.
	**THR MIN** This symbol appears when changing the **Event Threshold**.

LIT-UP SYMBOLS IN ADDITION TO DIGITS	FUNCTION DESCRIPTION
	MAX This symbol appears when the SPL maximum value is displayed.
	MIN This symbol appears when the SPL minimum value is displayed.
	The red LED on indicates the dB value of the amplifier gain set through RNG and ▲ and ▼ keys.

HOW TO CONNECT A DELTA OHM SOUND LEVEL METER TO A PC WITH WINDOWS OPERATING SYSTEM

Hardware connection:

1) The measurement instrument has to be off.
2) - Use Delta Ohm RS-232C cable, to connect the port of the instrument to the serial port available on the PC (COM1/COM2).
   - Note: the CP RS-232C cable ends with a female 25-pin connector; should the PC not be equipped with a compatible connector, use standard adapter usually on sale to connect them.
3) Turn the switch on the CP RS-232C wire to COMPUTER.

Software Connection with WINDOWS 3.1:

A) Start WINDOWS

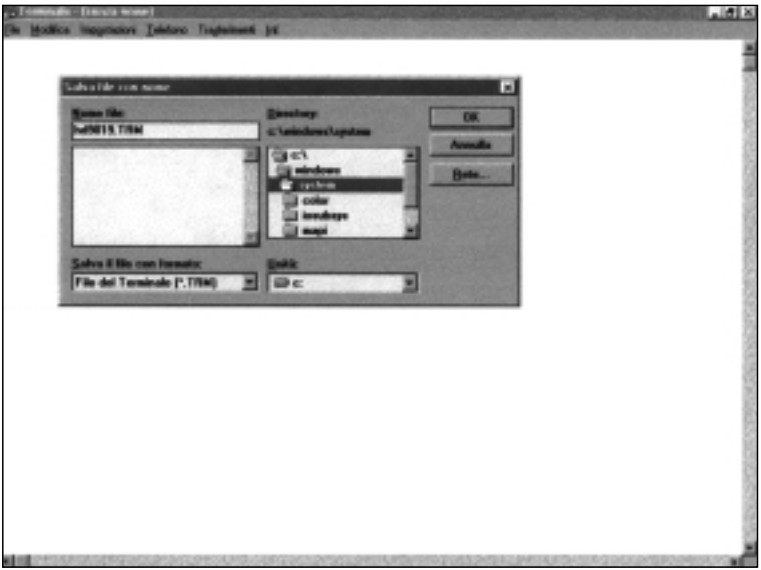
B) Select the ACCESSORIES window (Double-click)

C) Select TERMINAL and start the communication program (Double-click)

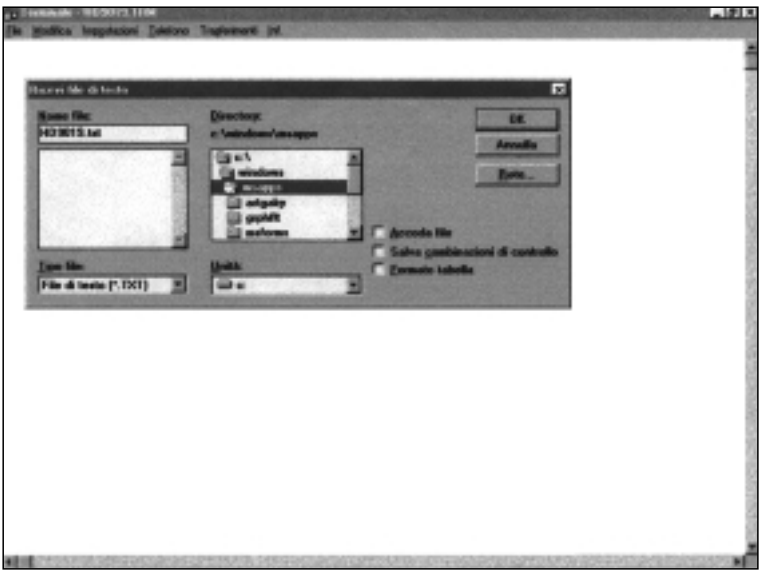
D) - Follow these instructions to change the terminal dialogue settings, and make them compatible with the instrument settings (if you did not already save a terminal setting file):

select SETTINGS on the terminal window (1 click)
select COMMUNICATIONS in the pop-up menu (1 click)
- the COMMUNICATIONS window appears on screen to set the dialogue modes; set:
  - BAUD RATE: 19200 and shall be the same set on the instrument (1 click)
  DATA BITS: 8 (1 click)
  STOP BITS: 1 (1 click)
  PARITY: none (1 click)
  FLOW CONTROL: Xon/Xoff (1 click)
  CONNECTOR: COM1 or COM2 according to the port used for the connection (1 click)
  PARITY CONTROL and CARRIER DETECT shall remain marked
OK to confirm (1 click)

E) - To save this setting on terminal:
select FILE on the terminal window (1 click)
- select SAVE AS in the pop-up menu and the SAVE FILE AS window will appear (1 click)
enter the name of the terminal setting file in the box (up to 8 characters)
OK to confirm and save the configuration (1 click)



F) To receive and store instrument data:
select TRANSFER on the terminal window (1 click)
select RECEIVE TEXT FILE in the pop-up menu and the window appears (1 click)
enter the name of the file where data have to be stored (up to 8 characters)
OK to confirm and start storing (1 click)



Now the terminal is ready to receive data from the instrument. All data the instrument will send will be stored on the a.m. file.

G) Turn the sound level meter on.

When the power-on routine is over, start downloading data stored on the internal memory using the P6 program (see the user's manual), and press the START/STOP key.

H) Ending storage of data received by the instrument:
select TRANSFER on the terminal window (1 click)
select STOP in the pop-up menu to stop storing (1 click)

The software goes back to the terminal window.

I) How to quit TERMINAL:
select FILE on the terminal window (1 click)
select QUIT in the pop-up menu (1 click)

The text file, containing data received from the measurement instrument connected to the PC, is now stored on your computer. To read and process this file, you can use any word or data processing program available on Windows environment (WORD, EXCEL, WORKS, etc.).

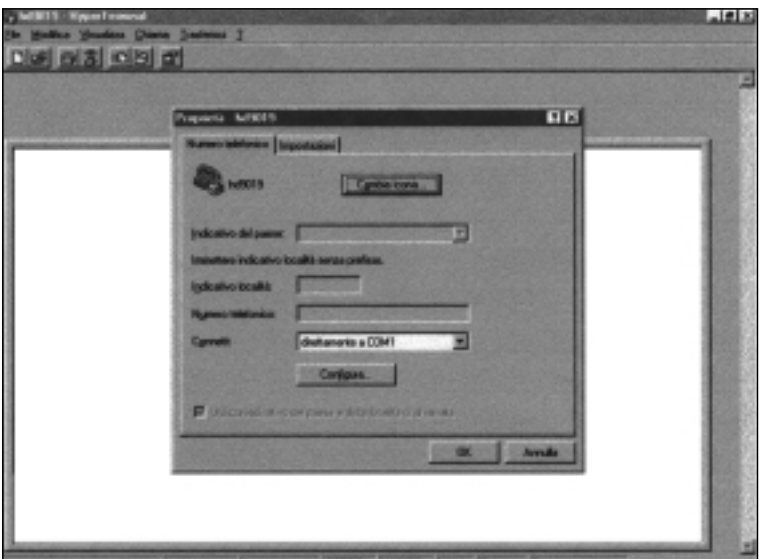
Software Connection with WINDOWS 95.

A) - Start WINDOWS 95 and select START, PROGRAMS, ACCESSORIES, HYPERTERMINAL. Execute HYPERTRM (double-click).

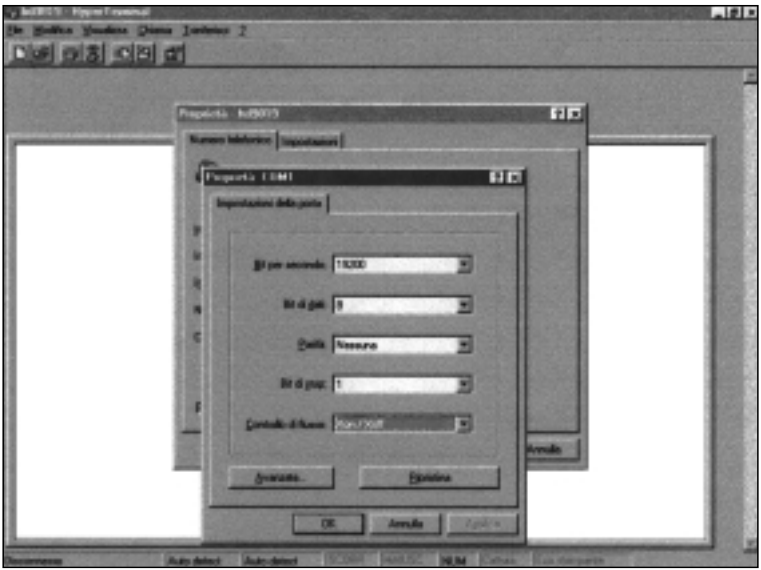
B) Communication name.
- On the “Connection description” window, enter a name for the communication you want to activate and select an icon (you will be allowed, by next communications, to activate directly the selected icon instead of HYPERTERM, automatically recovering all settings saved under that icon).

C) Setting the communication:

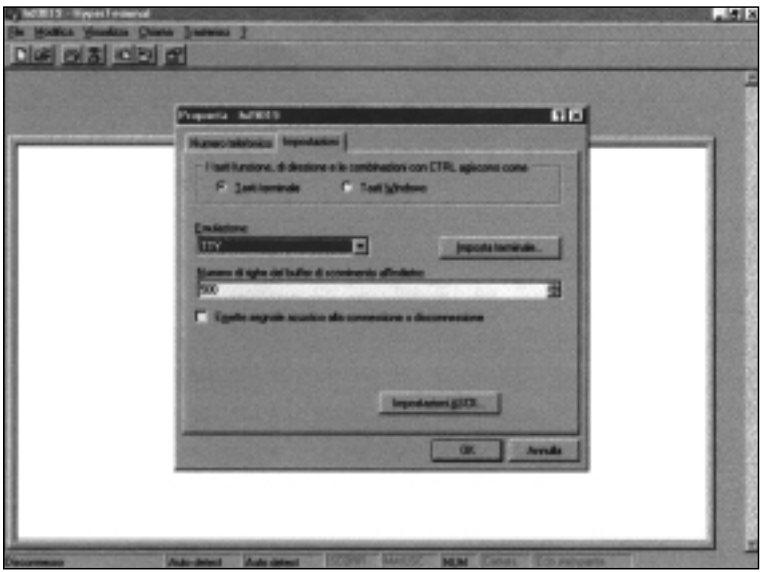
- on the Hyper Terminal window, select FILE (1 click)
- - select PROPERTIES (1 click) in the pop-up menu: the “Properties” window appears
- - in the “telephone number” folder, choose for Connect to, “directly to COM1” or to COM2, depending on the serial port you are going to use to communicate with the measurement instrument.



- -in the “telephone number” folder, select CONFIGURE (1 click) and the “Port settings” folder will appear
- in the “port settings” folder, select:
  BIT / SECOND: 19200
  DATA BITS: 8
  PARITY: None
  STOP BITS: 1
  FLOW CONTROL: Xon / Xoff
  OK to confirm the port setting (1 click)

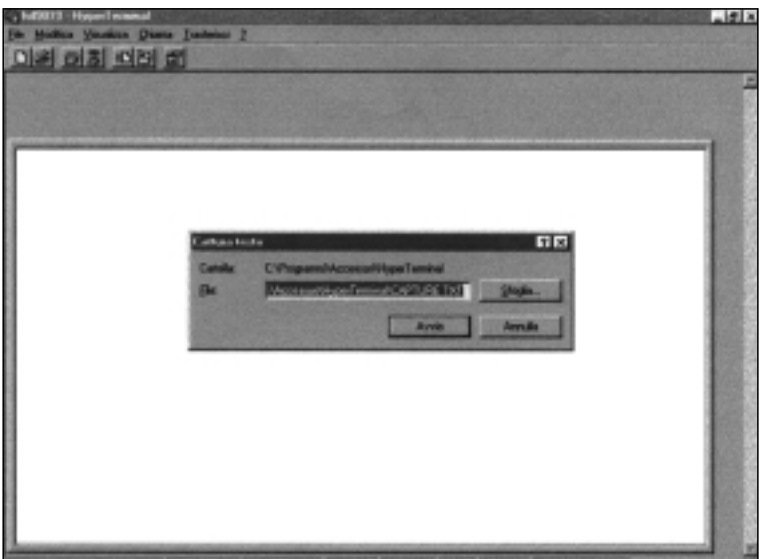


- select SETTINGS to display the “Settings” folder.
- in the “Settings” folder, select TTY for “Emulating” property
- OK to confirm set “Properties” (1 click)



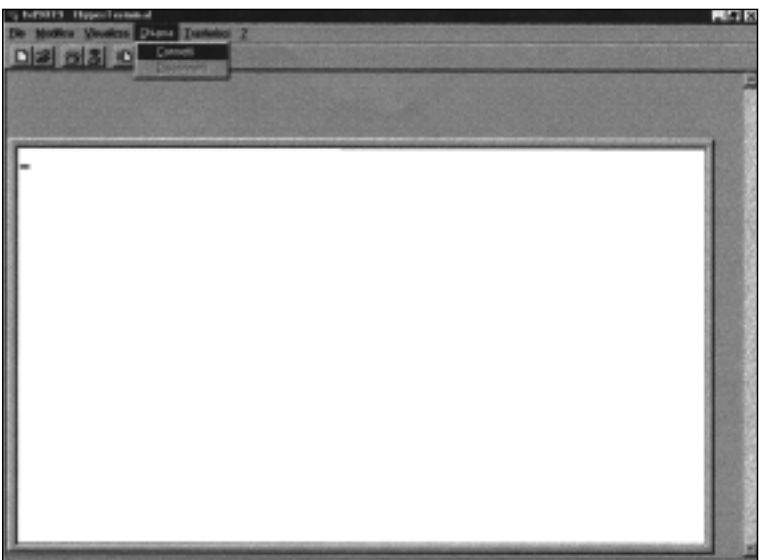
D) To receive and store data from an instrument:

- on the Hyper Terminal window: select TRANSFER (1 click)
- - select RECEIVE TEXT FILE in the pop-up menu (1 click). A window appears to set the name of the file where data received from the instrument have to be stored.
- type the name of the file where received data have to be stored
- OK to set the name of the receiving file (1 click)



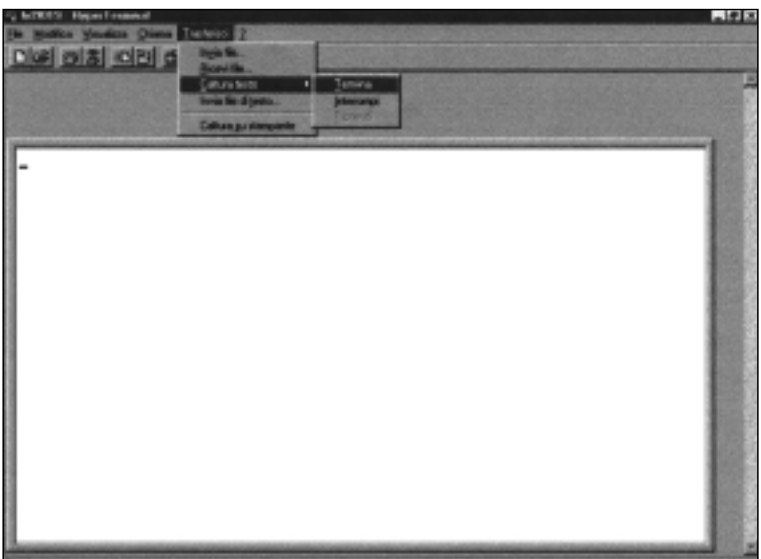
- select DIAL on the Hyper Terminal window (1 click)
- select CONNECT in the pop-up menu

Now the Hyper Terminal software can receive data from the measurement instrument and store them on the set file.



E) To interrupt receiving data from an instrument:
- select TRANSFER on the Hyper Terminal window (1 click)
- select RECEIVE TEXT FILE in the pop-up menu (1 click)
- select STOP in the pop-up submenu (1 click)

Now data from the instrument have been received and the file stored on the computer can be used with software packages compatible with WINDOWS 95.



F) To quit the Hyper Terminal:
- select FILE on the Hyper Terminal window
- select QUIT in the pop-up menu.

TECHNICAL SPECIFICATIONS

HD 9019 and HD 9020 with HD 9019S/1 probe are precision sound level meters, suitable to measure impulsive noises, according to IEC 651 (CEI EN 60651/1994) and IEC 804 (CEI EN 60804/1994) specifications for type 1 instruments. One-third octave band filters comply with type 2 IEC 1260 (CEI EN 61260/1995) specifications.
These instruments are suitable to be used either in laboratories, or in general purpose and on-field measurements.
The sound level meter calibration has to be carried out using a calibrator conforming at least to class 1 of IEC 942 (IEC 60942/1997) specifications, like Delta Ohm HD 9101 calibrator.

MEASUREMENT RANGES: 4 ranges overlapped of 40 dB provided with an overload indicator.

Amplifier (RNG)	Measuring range
60 dB	20÷80 dB
40 dB	40÷100 dB
20 dB	60÷120 dB (main range)
0 dB	80÷140 dB

FREQUENCY WEIGHTINGS: A, B, C, D (**HD 9019 only**)
LIN (linear) from 16 Hz to 16 kHz (Δ = -1 dB)
OCTAVE (1/3 octave) from 16 Hz to 20 kHz.

SPL TIME WEIGHTINGS: SLOW (1 second)
FAST (125 ms)
IMPULSE (35 ms rise time, 1.5 s fall time).

LEQ MEASUREMENT: integration time programmable from 1/8 s to 12 h.

CALCULATION OF: SEL, 8-hour estimated DOSE (**HD 9019 only**) and current DOSE (**HD 9019 only**). Storage of minimum and maximum sound pressure levels.

AUXILIARY DEVICES:
- Digital display with 0.1 dB resolution.
- 512 kB internal memory bank for data.
- Monitoring and statistical analysis program.
- Frequency analysis program.
- Reverberation time measurement program (**HD 9019 only**).
- Automatic calibration.
- RS-232C interface.
- DC 20 mV/dB analogue output.
- AC pre and post filter analogue outputs.
- 6÷9 VDC mains power supply input.

- Auto power-off (after 8 minutes).
- Calendar.
- Extension cable for probes.
- Tripod.
- Windscreen.

WARM-UP TIME: 60 sec.

MAIN MEASUREMENT RANGE WITH HD 9019S/1 PROBE: 60÷120 dB (RNG = 20 dB).

REFERENCE LEVEL: 94 dB.

REFERENCE FREQUENCY: 1000 Hz.

REFERENCE DIRECTION: probe longitudinal axis.

PEAK DETECTOR RISE TIME: <50 µs (-2 dB change).

LEQ STABILIZING TIME FOR CONSTANT LEVELS: 0.125 s (Δ = 0.1 dB).

LINEARITY RANGE: ≥ 60 dB.

IMPULSE LINEARITY RANGE: ≥ 63 dB.

ANALOGUE AND CONTROL OUTPUTS:

- VCRA: Input amplifier output (pre-filters)

amplitude	12	Vpp max
impedance	470	ohm
current	10	mA max

RNG (dB)	gain	
0	7.1	mV/Pa
20	71	mV/Pa
40	0.71	V/Pa
60	7.1	V/Pa

- VACPF: Frequency weighting filter output

amplitude	24	Vpp max
impedance	470	ohm
current	10	mA max

gain not calibrated and dependent on the selected filter

- Vdc: Continuous output of the measured SPL value

impedance	470	ohm
current	10	mA max
gain	20	mV/dB
Update freq.	8	Hz

- MUTE: - Sound source control output (bi-directional switch)

state ON	switch	closed
	impedance	30 ohm max
	current	120 mA max
state OFF	switch	open
	impedance	50 Gohm min
	voltage	400 Vac peak

SERIAL INTERFACE: Data baud-rate is selectable between: 0.6, 1.2, 2.4, 4.8, 9.6 and 19.2 kbauds.
The format is: 8 bit data length
1 start bit
1 stop bit
no parity
XON/XOFF flow control

SENSITIVITY TO EXTERNAL AGENTS:

Working temperature:	-10÷+50 °C
Storage temperature:	-10÷+70 °C
±10% atmospheric pressure variation:	±0.2 dB
-10÷+50°C temperature variation:	±0.4 dB
30÷90% relative humidity variation:	±0.5 dB

1/3 OCTAVE BAND-PASS FILTER

HD 9019 and HD 9020 with HD 9019S/1 conform to the IEC 1260 standard specifications with respect to the measurement of noise with 1/3 octave filters from 16 Hz to 20 kHz, type 2, for sound pressure levels included in the 30÷140 dB range.
These accuracy levels are achieved using the sound level meter together with the HD 9019S/1 probe as root-mean-square meter of the filter output, and sending an electrical signal to the instrument input.

- Single band filter analogue sampling with 222 x fc sampling frequency, where fc is the centre frequency.
- 0 dB reference attenuation.
- The octave frequency ratio of the filter bank is determined with base 2.
- Reference range: 70÷120 dB (RNG=20 dB) with 94 dB reference level.
- 50 dB linear range with OVFL and UF indication of out of range input signals.
- Real time response over all frequency range
- The filter bank can make the frequency analysis only for repetitive or constant signals for the whole scanning time. Program 2 executes automatically the filter scanning from 16 Hz to 20 kHz, storing or printing the Leq measurements at 5 second steps (total time about 3'15").

MK221 CONDENSER MICROPHONE CAPSULE

TECHNICAL SPECIFICATIONS

- Transducer: free-field response condenser transducer
* - Working frequency: from 20 Hz to 20 kHz
* - Sensitivity: 50 mV/Pa
- Max. working limit: 146 dB
* - Capacitance equivalent value (with 1 kHz frequency and polarization voltage): 20 pF
- Polarization voltage: 200 V ±10%
- Temperature working range: -50÷+110°C (not to be used for a long time at max. values)
- Temperature coefficient: 0.01 dB/K
- Static pressure coefficient: -0.001 dB/hPa
- Diameter: 1/2" standard: 13.2 ±0.05 mm

* *Values singularly tested*

ORDER CODE

HD 9019 kit 1: the kit includes a carrying case, a HD 9019 sound level meter, a HD 9019S/1 probe, a HD 9101 calibrator, a CPA/3 extension wire, a HD SAV windscreen and a CPRS232C serial wire.

HD 9020 kit 1: the kit includes a carrying case, a HD 9020 sound level meter, a HD 9019S/1 probe, a HD 9101 calibrator, a CPA/3 extension wire, a HD SAV windscreen and a CPRS232C serial cable.

HD SAV: windscreen suitable for 1/2" microphone.

HD 9019S/1: spare probe equipped with type 1 accuracy preamplifier, according to IEC 651.

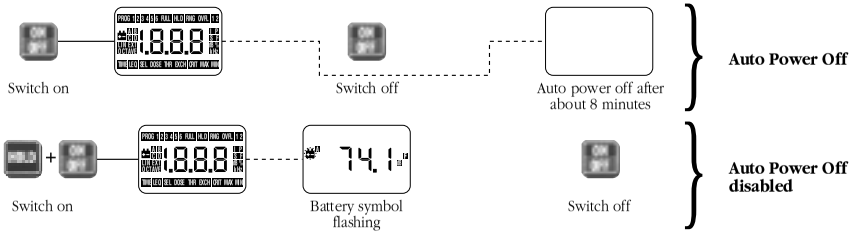
HD 9101: calibrator type 1 IEC 60942 (CEI EN 60942/1999), 1000 Hz frequency, 94 dB/114 dB signal intensity.

Case: carrying case to contain both the instrument and relevant accessories.

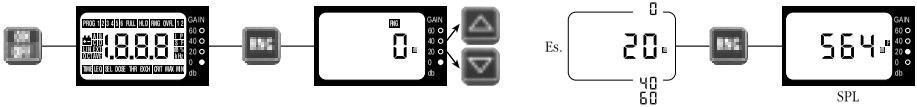
Tripod: to support either the HD 9019S/1 probe or the instrument itself. Height: 45/120 cm.

EXAMPLES

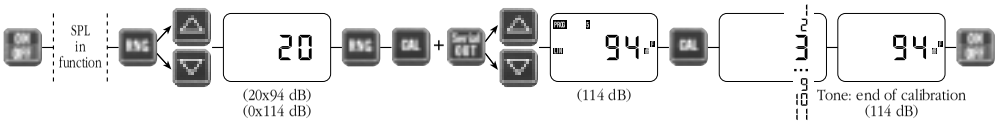
1) Power on and off of the instrument



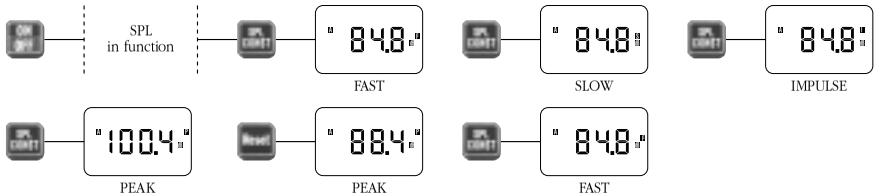
2) Amplifier setting (gain)



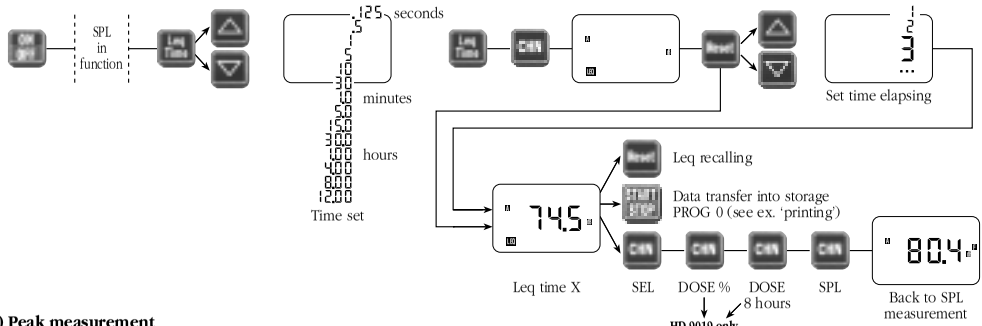
3) Calibration



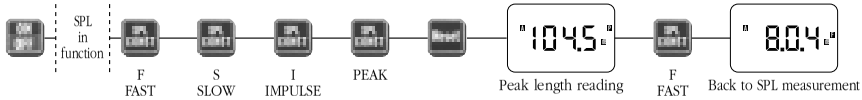
4) SPL current values measurement



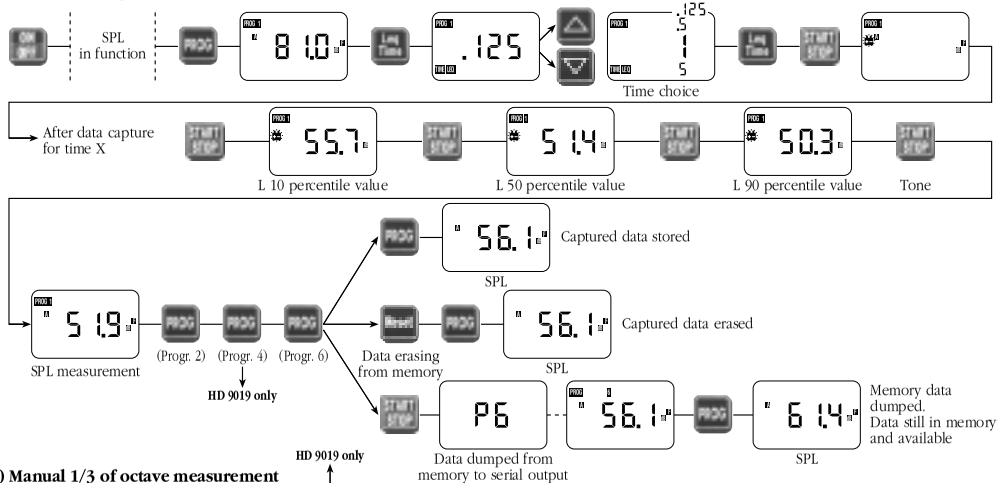
5) Equivalent level measurement, Leq



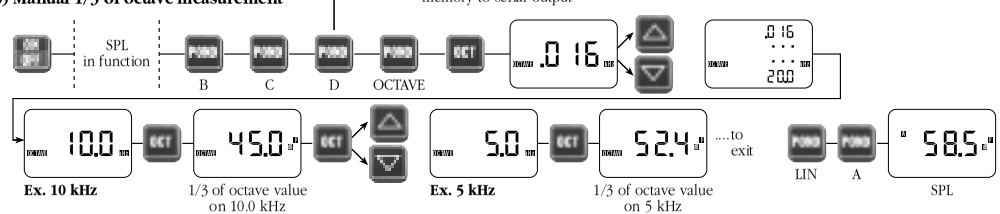
6) Peak measurement

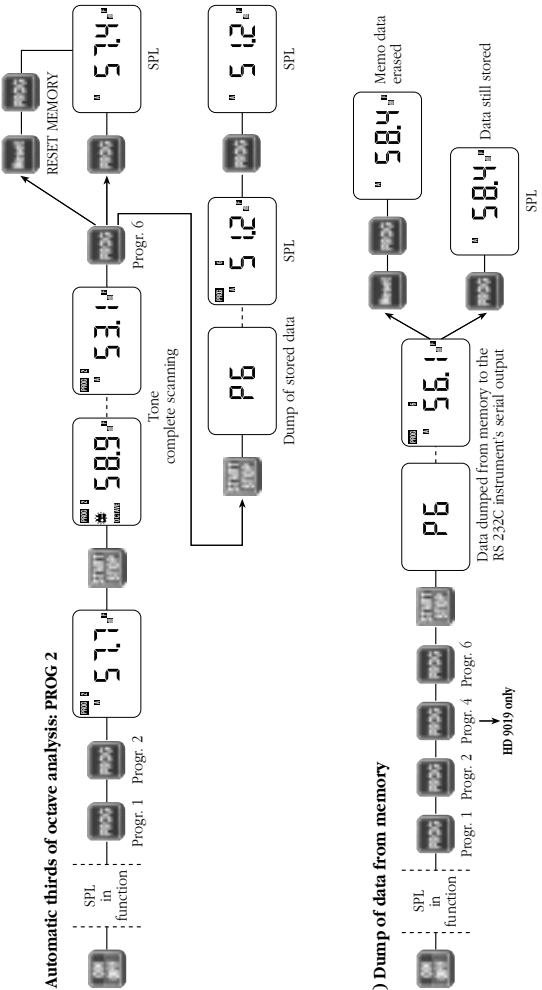


7) Statistical analysis: PROG 1

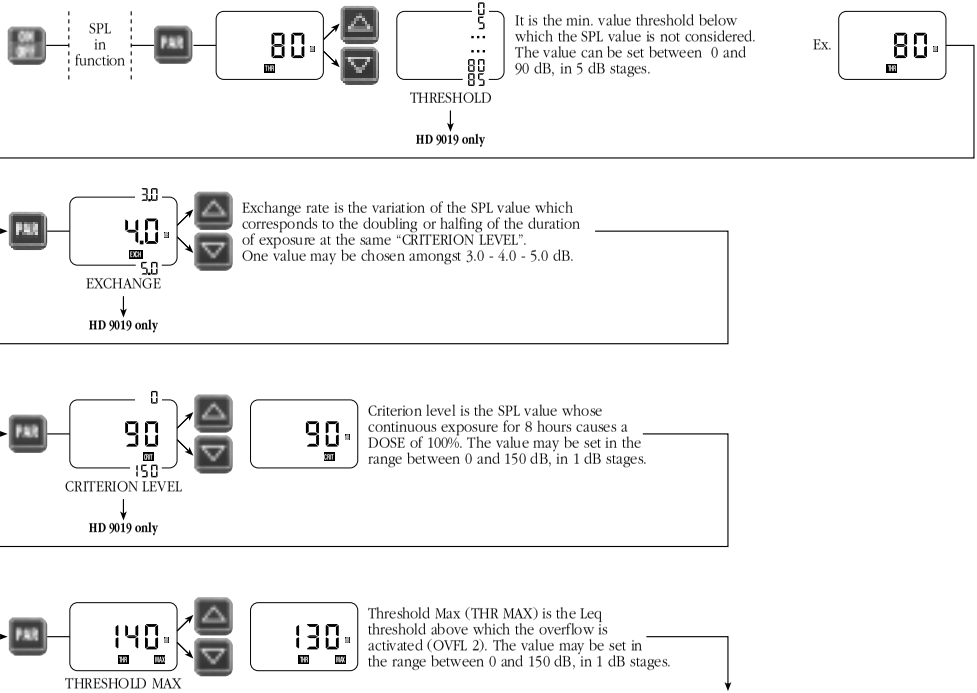


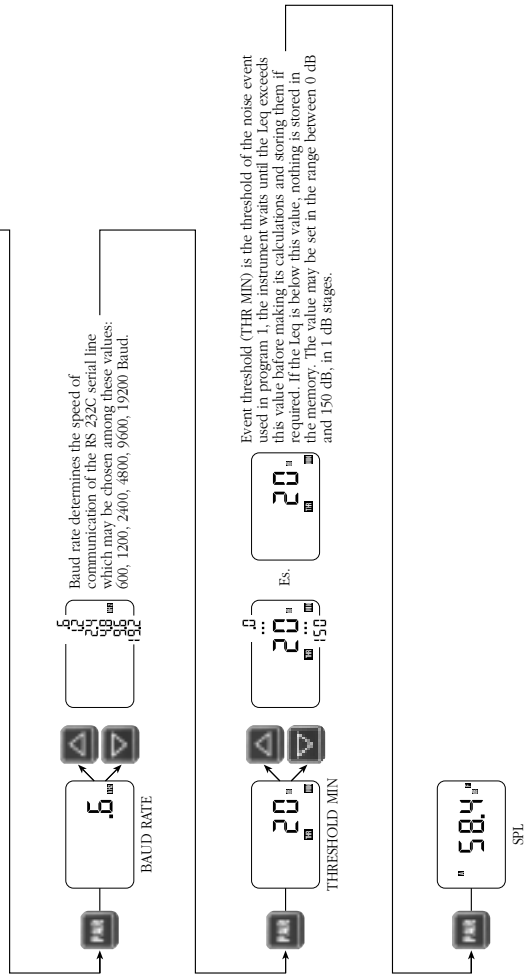
8) Manual 1/3 of octave measurement




9) Automatic thirds of octave analysis: PROG 2
SPL in function
Progr. 1
Progr. 2
57.7
Tone complete scanning
58.9
53.1
Progr. 6
RESET MEMORY
57.4
SPL
P6
Dump of stored data
51.2
SPL
10) Dump of data from memory
SPL in function
Progr. 1
Progr. 2
Progr. 4
Progr. 6
HD 9019 only
P6
56.1
Data dumped from memory to the RS 232C instrument's serial output
58.4
Memo data erased
58.4
Data still stored
SPL

11) Parameters key (PAR)


ON OFF
SPL in function
PAR
80
THR
It is the min. value threshold below which the SPL value is not considered. The value can be set between 0 and 90 dB, in 5 dB stages.
THRESHOLD
HD 9019 only
Ex.
80
THR
PAR
3.0
4.0
EXCH
5.0
Exchange rate is the variation of the SPL value which corresponds to the doubling or halfing of the duration of exposure at the same "CRITERION LEVEL". One value may be chosen amongst 3.0 - 4.0 - 5.0 dB.
EXCHANGE
HD 9019 only
PAR
0
90
CRI
150
90
CRI
Criterion level is the SPL value whose continuous exposure for 8 hours causes a DOSE of 100%. The value may be set in the range between 0 and 150 dB, in 1 dB stages.
CRITERION LEVEL
HD 9019 only
PAR
140
THR MAX
130
THR MAX
Threshold Max (THR MAX) is the Leq threshold above which the overflow is activated (OVFL 2). The value may be set in the range between 0 and 150 dB, in 1 dB stages.
THRESHOLD MAX


BAUD RATE
Baud rate determines the speed of comunnication of the RS 232C serial line which may be chosen among these values: 600, 1200, 2400, 4800, 9600, 19200 Baud.
THRESHOLD MIN
Es.
Event threshold (THR MIN) is the threshold of the noise event used in program 1, the instrument waits until the Leq exceeds this value before making its calculations and storing them if required. If the Leq is below this value, nothing is stored in the memory. The value may be set in the range between 0 dB and 150 dB, in 1 dB stages.
SPL

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